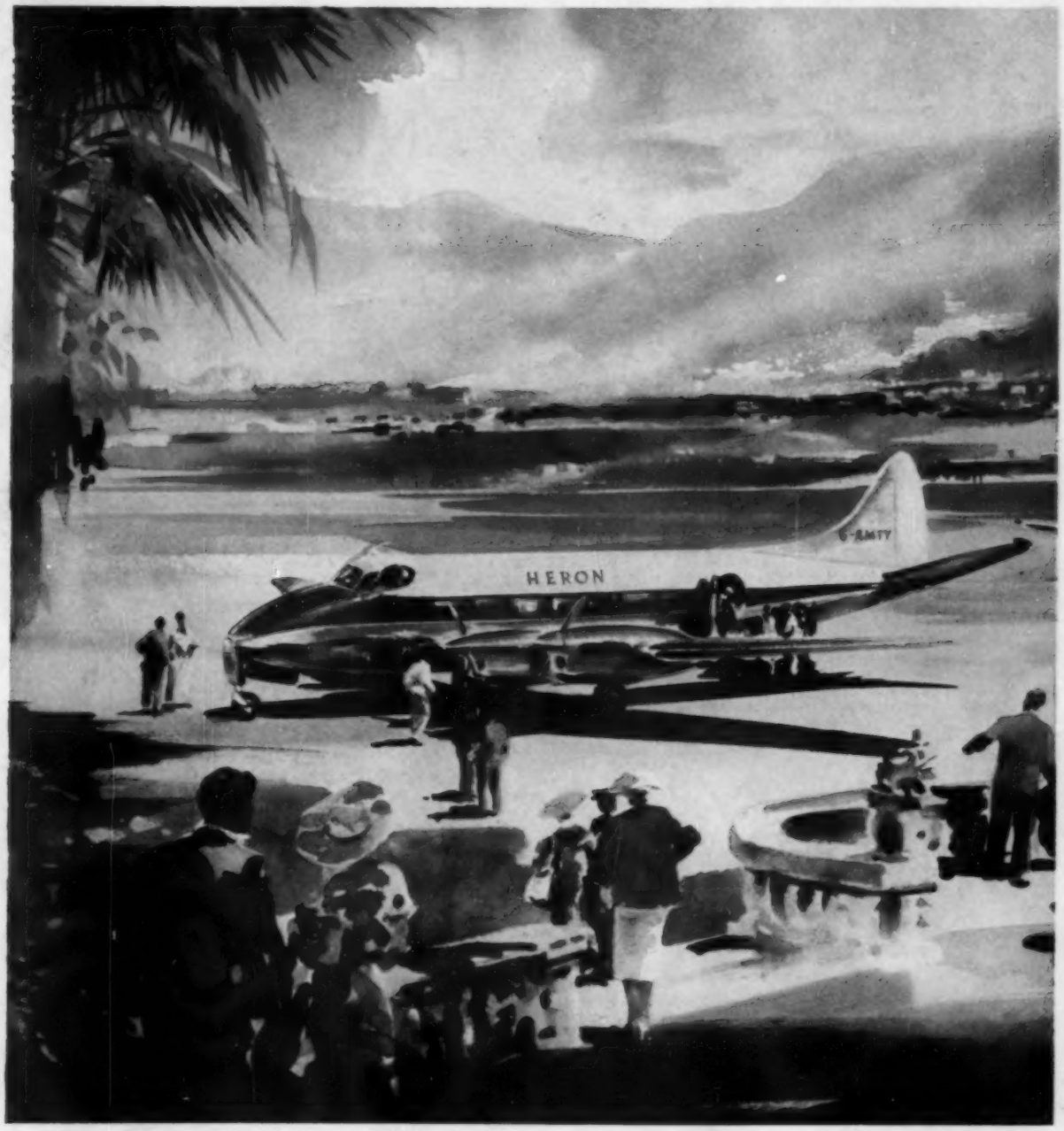
Flight
27 AUGUST 1954

ONE SHILLING & SIXPENCE

FLIGHT

OFFICIAL ORGAN OF THE ROYAL AERO CLUB

COMMONWEALTH
AIRCRAFT INDUSTRIES



Frequency and branch-line traffic

Four de Havilland Gipsy Queen 30 Mark 2 engines, each 250 b.h.p., driving de Havilland two-bladed, variable-pitch, non-feathering propellers

DE HAVILLAND HERON SERIES 2

FOREMOST IN HIGH-PRECISION HYDRAULICS

19 YEARS DESIGN AND PRODUCTION OF HYDRAULIC STRUTS

ALL-BRITISH

Lockheed

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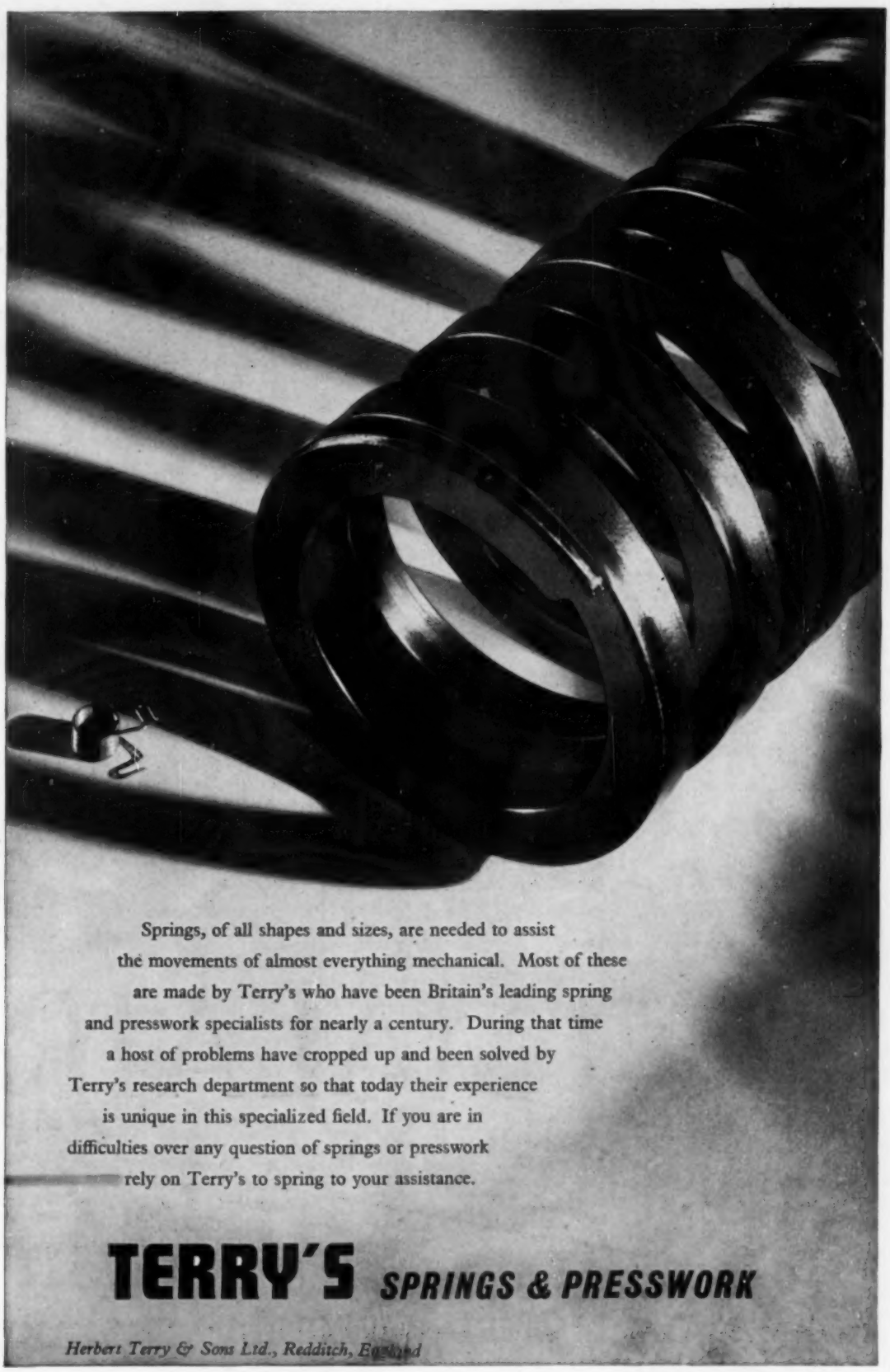
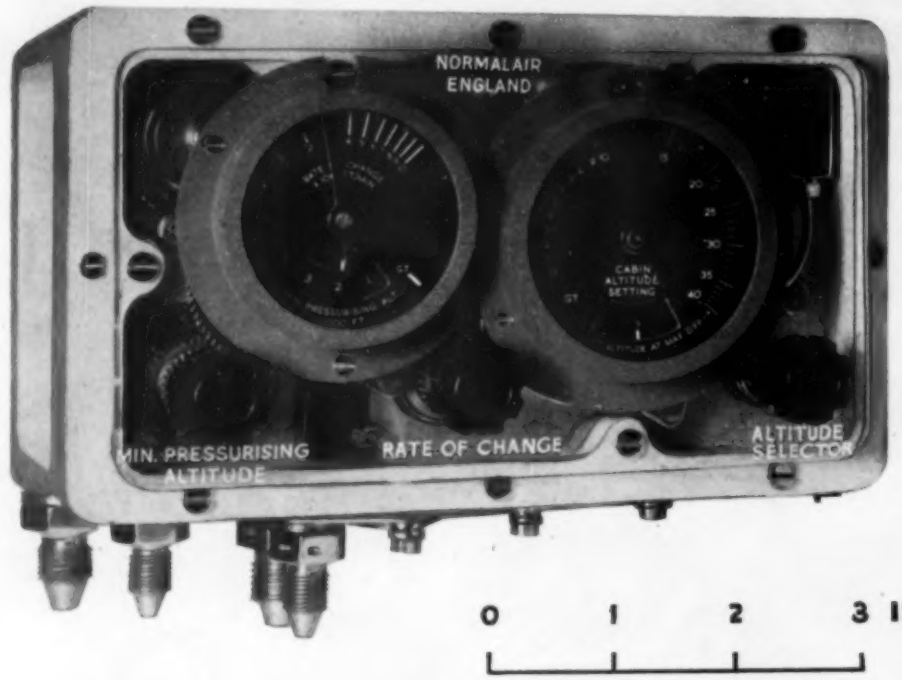

Springs, of all shapes and sizes, are needed to assist
the movements of almost everything mechanical. Most of these
are made by Terry's who have been Britain's leading spring
and presswork specialists for nearly a century. During that time
a host of problems have cropped up and been solved by
Terry's research department so that today their experience
is unique in this specialized field. If you are in
difficulties over any question of springs or presswork
rely on Terry's to spring to your assistance.
TERRY'S SPRINGS & PRESSWORK
Herbert Terry & Sons Ltd., Redditch, England



PRESSURE CONTROLLER

This unit automatically controls cabin pressure to a given required value. It normally operates in conjunction with the Normalair Type 30/SC discharge valve, in that it supplies operating pressures to that unit. The Type D pressure controller represents a considerable advance in design, it is very much smaller and it weighs less than half its predecessor.

NORMALAIR LTD

Technical Service across the world

NORMALAIR (Australia) PTY. LTD.
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near Melbourne, Victoria
NORMALAIR (Canada) LTD.
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Serving Canadian Aviation

Field Aviation Company's fully equipped shops at Oshawa, Ontario, near Toronto, provide maintenance and overhaul facilities used by the Royal Canadian Air Force and other clients; and Field's Western Division maintains complete aircraft servicing shops at Calgary, Alberta. In addition the following company divisions are Canadian agents for equipment ranging from high-altitude clothing and parachutes to conventional and rotary-wing aircraft and jet engines:

AGENCY SALES DIVISION

Municipal Airport, Oshawa, Ontario

Field's Agency Sales Division is exclusive Canadian agency for leading aviation equipment firms, including:
Smiths Aircraft Instruments Ltd.
Bryans Aeroquipment Ltd.
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Fireproof Tanks Ltd.
The Ulster Weaving Company
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Sky-Hi Limited.

AIRCRAFT SALES DIVISION

1450 O'Connor Drive, Toronto 16, Ontario

Field's Aircraft Sales Division, with offices in Toronto and Calgary and extensive contacts with affiliated companies overseas, specializes in custom sale of aircraft in all parts of the world. Aircraft manufacturers represented by the Aircraft Sales Division include: Beechcraft, Blackburn, Hiller, and Hunting Percival.

GAS TURBINE DIVISION

Municipal Airport, Oshawa, Ontario

Field's Gas Turbine Division is sole Canadian agent for the complete line of Blackburn-Turboméca engines, which includes aviation jet turbines as well as shaft-drive and air-compressor turbine engines for industrial use. The Gas Turbine Division also provides consultant engineering and overhaul facilities.

FIELD AVIATION COMPANY LIMITED

Affiliated with Field Aircraft Services Ltd., Croydon, England, and companies in South Africa, East Africa, Rhodesia, Australia, New Zealand, and other countries.

The PROTECTION of ALUMINUM

"ALODINE" PROTECTS BOTH PAINTED AND UNPAINTED ALUMINUM

"Alodine" forms an amorphous non-metallic surface on aluminum which is thin, tough, durable, continuous with and a part of the basis metal. The "Alodine" film (or skin) anchors paint, prolongs paint life, and protects aluminum exposed unpainted to the atmosphere.

ALODIZING IS EASY AND EFFECTIVE

The Alodizing process is a chemical one and does not require electrolytic techniques or equipment. Alodizing is simple, fool-proof, low in cost, and requires a minimum of equipment. Essentially, the process consists of the following easily controlled operations or steps:

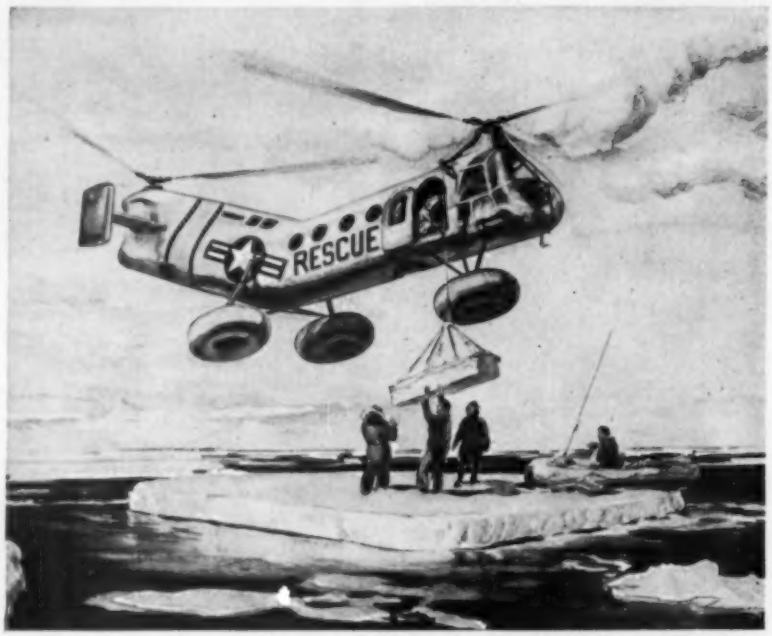
1. Cleaning the work.
2. Rinsing the cleaned aluminum surfaces.
3. Coating with "Alodine."
4. Rinsing with clean water.
5. Rinsing with warm "Deoxylyte" (acidulated rinse).
6. Drying.

AFTER TREATMENTS: Alodized aluminum provides an ideal bonding surface for paint, wax, adhesive, or other organic finishes. These should be applied in accordance with the manufacturer's directions. Unpainted or exposed areas will be protected by the tough, durable "Alodine" skin.

"ALODINE" MEETS SERVICE SPECIFICATIONS

"Alodine" applied by immersion or spray complies with the rigid performance requirements of both industrial and Government specifications. The following is a list of Service Specifications which "Alodine" meets.

MIL-C-5541	U.S. Navord O.S. 675
MIL-S-5002	16E4 (SHIPS)
AN-E-19	AN-C-170 (See MIL-C-5541)
AN-F-20	U.S.A. 72-53 (See AN-F-20)



Drawing courtesy of Piasecki Helicopter Corporation, Morton, Pennsylvania

THE H-21 Piasecki Tandem Helicopter—the "Work Horse"—is ideally suited for rescue work in areas inaccessible by other means, and in all kinds of rough weather.

For durable paint adhesion and high corrosion-resistance aluminum parts of the "Work Horse" are Alodized. The "Alodine" protective coating chemical bonds paint, extends paint life, and protects unpainted aluminum.

Because of its economy, effectiveness, and ease of application, the Alodizing process is finding wide-spread use in the aircraft field and in other industries fabricating products of aluminum.

Alodized aluminum meets the requirements of Military Specification MIL-C-5541. Write or call for coating and process data on "Alodine".

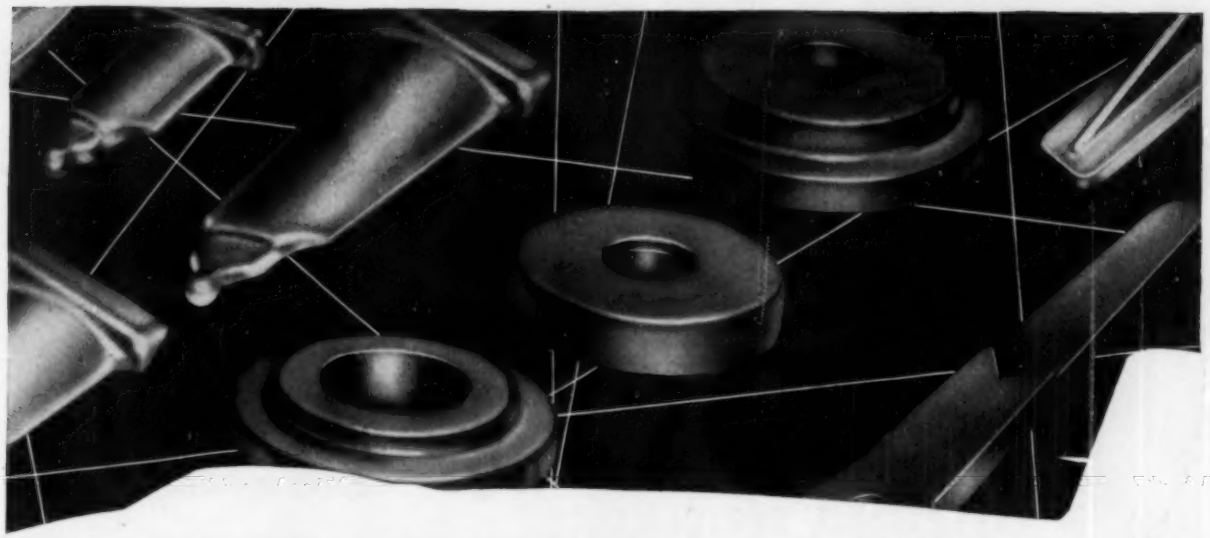
"Alodine" Trade Mark Reg. U. S. Pat. Off.

CHEMICALS ACP PROCESSES

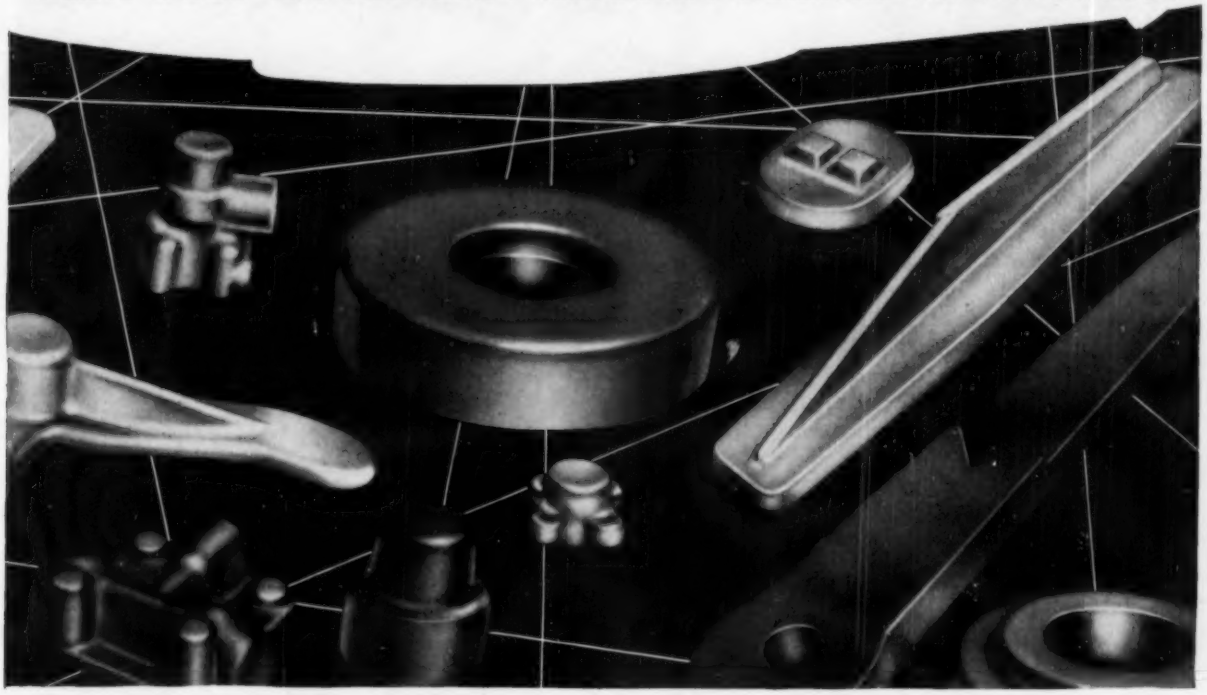
AMERICAN CHEMICAL PAINT COMPANY

WINDSOR, ONT.

Ambler, Penna. Detroit, Mich. Niles, Calif.



WHAT DOES THE AIRCRAFT INDUSTRY DEMAND IN FORGINGS?



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We have the experience, equipment, organization and technical ability to meet these exacting forging requirements.

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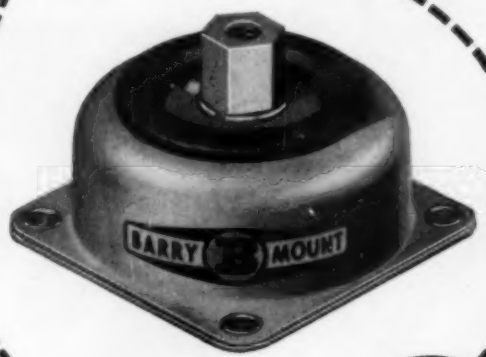
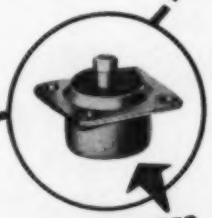
for the protection of all types of airborne equipment . . .





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There are also BARRYMOUNTS available for specialised vehicle-borne and ship-borne equipment applications.

Air-damped BARRYMOUNTS are supplied in a wide range of sizes for Rated Loads of from 0.1 to 35 lbs. We invite enquiries for special "ALL-METL" types designed for prolonged service and efficiency in aircraft at extreme operating temperatures.

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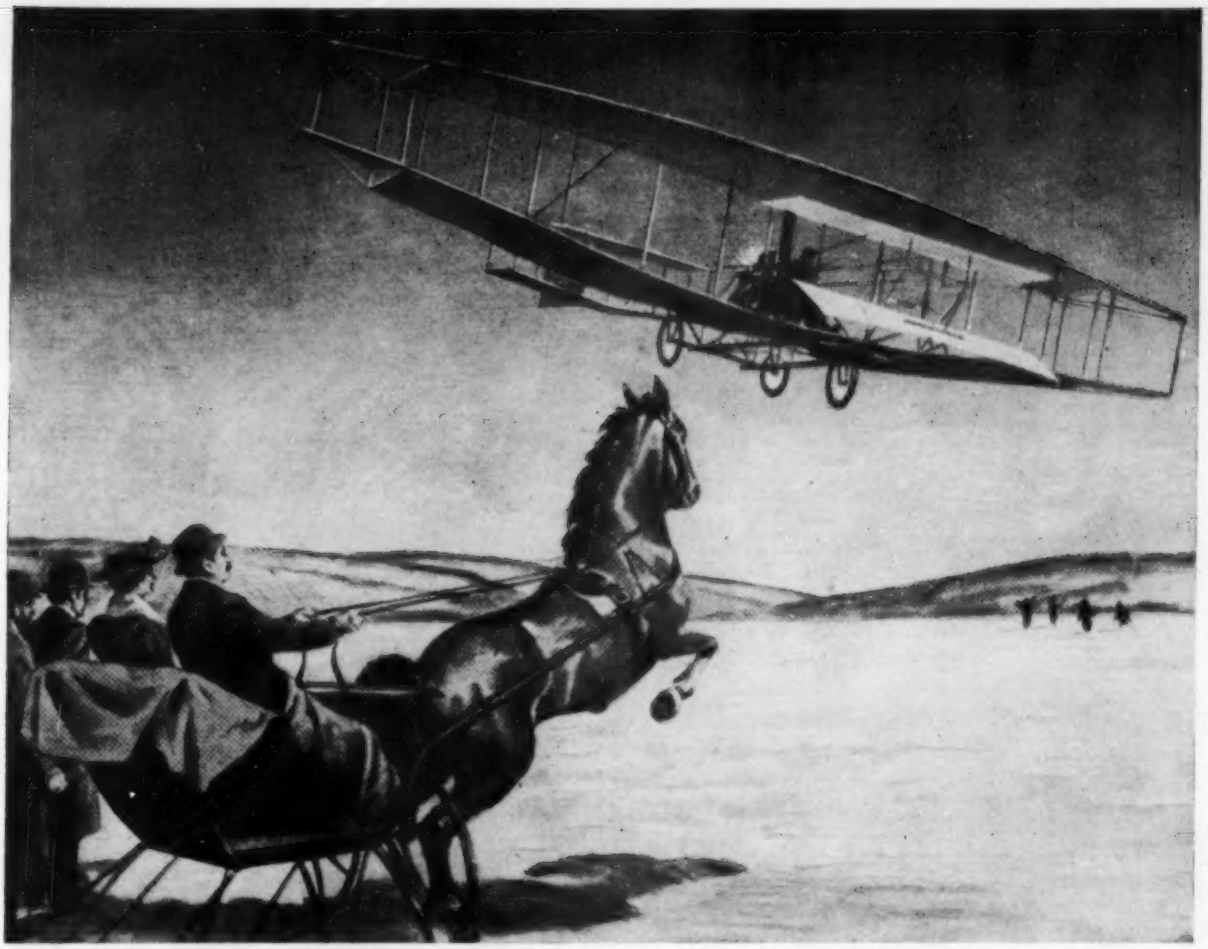

THE "Silver Dart" THAT GAVE WINGS TO A NATION

A YOUNG NATION "got its wings" when John A. D. McCurdy's *Silver Dart* flew for three-quarters of a mile over the Bras d'Or lakes near Baddeck, Nova Scotia—the first powered flight in Canada, in fact, in the entire Commonwealth.

That was February 23, 1909. One year later, in its Coventry factory, Dunlop turned to producing tires and wheel rims for aircraft. Dunlop, too, was launched into the air age.

This early interest in aviation at Dunlop was natural. For however man chooses to move—by land, sea or air—or wherever a wheel turns or power is transmitted—Dunlop research and production facilities have a job to do. Movement of people and products is Dunlop's business.

Today, Canada is a nation of air power—here is where Dunlop aircraft products contribute strength or speed or safety or comfort. Better design, safer operation, increased efficiency. That's the role of Dunlop, helping to make Canada strong in the air.

Enquiries are invited by the—

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DUNLOP TIRE AND RUBBER GOODS COMPANY, LIMITED, Toronto, Canada

LIGHTWEIGHT AIR-PRESSURE REDUCING VALVE

For recuperator, fuel and hydraulic header tank pressurisation, auto pilot actuation, fuel transfer, pressure cabin sealing. Extremely compact and weighing less than 6 ounces, the PS.29 series valves deal with input pressures between 2½ p.s.i. and 1800 p.s.i. and output low pressures closely controlled with adjustment between 2½ p.s.i. and 25 p.s.i. A low pressure relief valve is built in.

This illustration is twice actual size.

Hymatic

THE HYMATIC ENGINEERING CO. LIMITED • REDDITCH • WORCESTERSHIRE

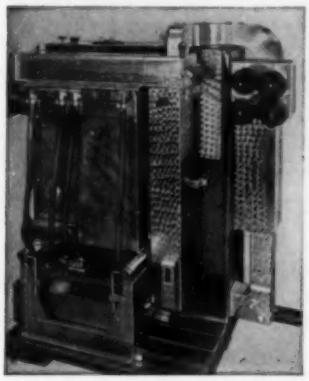
137

PSC APPLIED RESEARCH LIMITED

A Canadian company specializing in custom design and production

SOLVED THESE PROBLEMS:

PROBLEM: To develop a transportable film processor that will process and dry 16, 35 and 70 mm film at rates up to 20 feet per minute. Must be easy to operate, requiring no technical personnel, no darkroom, no threading, no leader. Essential that process be controlled entirely by mechanical program unit after film is loaded.



ANSWER:

AUTOMATIC TRI-FILM PROCESSOR

(Type T246)

designed, engineered and produced by PSC Applied Research Ltd.

PROBLEM: To design an instrumentation camera for automatic recording on 35 mm film, with a wide range of remotely controllable exposure and interval times. Must incorporate simple magazine loading and quick-release mounting. Uses will include instrument panel recording, radar and oscilloscope recording, aerial survey positioning, plotting table records, etc.

ANSWER:

INSTRUMENTATION CAMERA

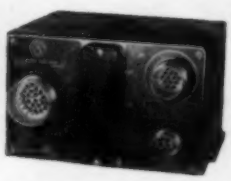
(Type T232 Mark 6)

designed, engineered and produced by PSC Applied Research Ltd.

PROBLEM: To adapt for general aircraft application the fully automatic aircraft ice detector and shedding control system originated by the National Research Council of Canada.

ANSWER:

Sensitive Pressure Switch
3½" x 4½" x 4½"
Wt. 2 lbs.



Shedding Area Controller
8½" x 4½" x 6½"
Wt. 9 lbs. 4 ozs.

Ice Detector Wt. 6 ozs.
3" Probe

The first fully automatic **AIRCRAFT ICE DETECTOR AND SHEDDING CONTROL SYSTEM**, manufactured by PSC Applied Research Ltd. under licence from National Research Council.

(This automatic system is used on CF-100 all-weather fighter; detector and pressure switch are used for engine intake ice detection on F86E Sabre Jet.)

PROBLEM: To design and produce an intervalometer to control aircraft rocket fire pattern.

ANSWER:

ARMAMENT INTERVALOMETER

(Type T2490) designed, engineered and produced by PSC Applied Research Ltd.

For analysis of **your** problem, write:

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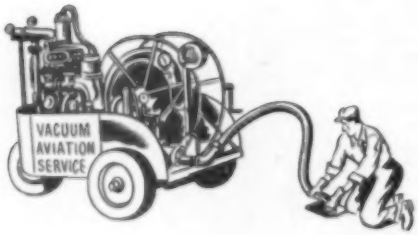
in these fields: electronic, mechanical, optical, photographic, photogrammetric, survey, automatic control systems, computers.

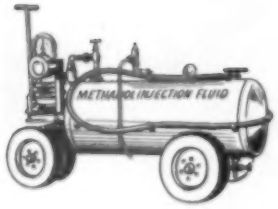
VACUUM AVIATION SERVICE in Australia and the Islands of the Pacific



Marketing a full range of Aviation Gasolines from 115/145 down to 73 octane—as well as Aviation Turbo Fuel—the Vacuum Oil Company Pty. Ltd. serves the interests of aviation from New Guinea to Tasmania; from Western Australia to Fiji. With those fuels is a range of lubricants including Mobiloil Aero Engine Oils, Mobil Aviation Special Oils and Greases, and special Lubricating Oil for turbines.

UNDERGROUND HYDRANT REFUELLING SYSTEM:

Introduction by Vacuum of underground hydrant refuelling systems has been an outstanding contribution to aviation in Australia. At Kingsford-Smith Airport (Sydney) and Nadi International Airport (Fiji) underground hydrants enable Vacuum to refuel aircraft at up to 400 gallons a minute. This system has been installed at seven other important centres in Australia and is planned at another 11 aerodromes.

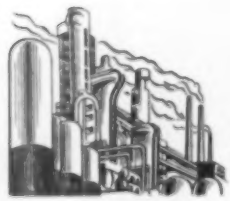


PNEUMATIC DISPENSERS:

Designed by Vacuum engineers, portable pneumatic dispensers for Aviation Oil and Methanol Mixture are in service at major airports.

FLAT-TOP REFUELLING WAGGONS:

For aerodromes not equipped with underground hydrant facilities, Vacuum designed and pioneered the new "flat-top" bulk refuellers capable of delivering 200 gallons of aviation gasoline a minute into aircraft tanks. 72 tank waggons are used by Vacuum's Aviation Service throughout Australia and the Islands of the Pacific—including 7 "flat-tops".



AVGAS AND JET FUEL FROM ALTONA:

Vacuum's refining affiliate—Standard-Vacuum Refining Co. Ltd.—has announced that Aviation Gasoline for Australian civil and military needs will be made at the company's refinery at Altona, near Melbourne, where a £17,000,000 expansion programme embracing construction of a Thermofor Catalytic Cracking Plant is nearing completion. This will be in addition to Aviation Turbo Fuel, which has been in regular production for some time at Altona Refinery.

VACUUM OIL COMPANY PTY. LTD.

(Incorporated in Australia)

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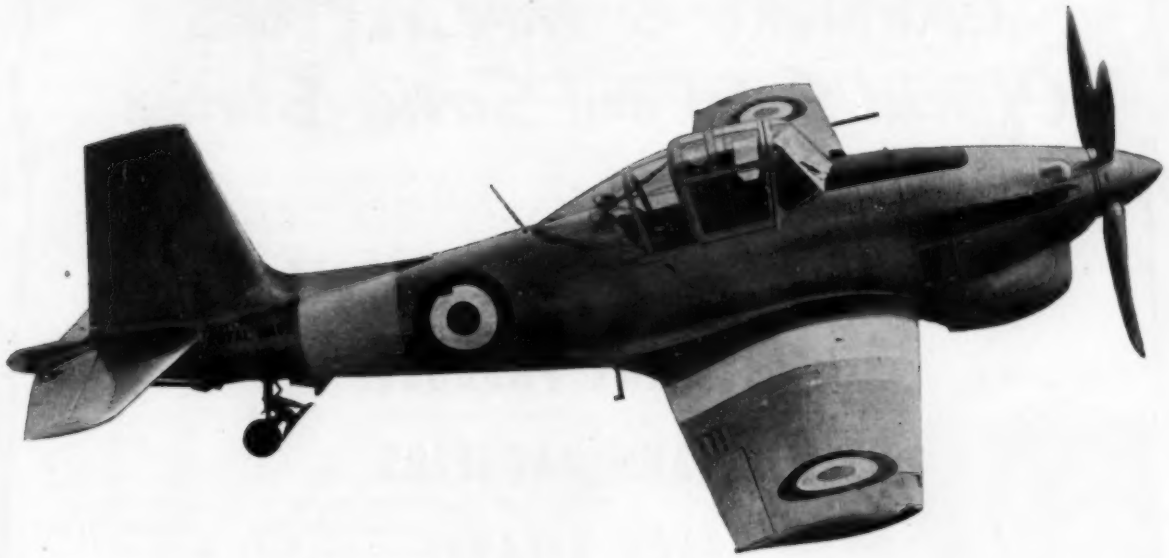
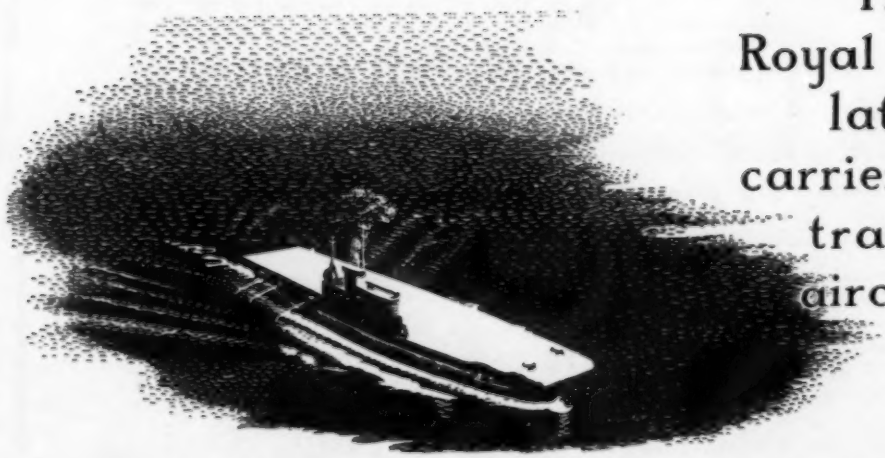
The
SEA BALLIOL





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PLEASE PASS ON TO RESEARCH AND DEVELOPMENT

Take-off Camera

INFORMATION SHEET

FLIGHT TEST EQUIPMENT

TAKE-OFF AND LANDING DATA

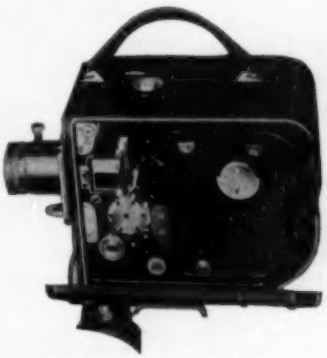
Application: The evaluation of aircraft performance on Take-off and Landing. The production of accurate and permanent records for Distance/Time and Distance/Height curves. Ground Speed. Rate of Climb, Take-off and Landing Speeds, Acceleration, etc.

Brief Specification: Motor-driven from 24-volt battery. **Lens:** 20 in. f5.6 coated Telephoto. **Film:** 70 mm. BSI Standard perforation. **Camera Speeds:** 120, 180 and 240 exposures per minute. **Exposure Times:** From 1/15 to 1/200 second. **Time Base:** Recording Stop-watch in 10 milli-second intervals. **Azimuth Bearings:** Accurate to six minutes of arc. **Magazines:** Clip-on type, 200 ft. capacity, sufficient for 640 exposures. **Viewfinder:** Erect brilliant image, adjustable for focus and parallax. **Tripod:** Quick-levelling, gyroscopic fly-wheel type, collapsible legs. **Fittings:** Film-footage counter, series-run counter, accelerator switch, voltmeter, instrument lamps, camera carrying bars.

INSTRUMENT OBSERVATION

Application: The reliable and automatic recording of instrument-panel readings. The production of permanent records on 35 mm. film for analysis after flight.

Brief Specification: **Film:** Standard 35 mm. negative. **Camera Drives:** 12-volt or 24-volt. Selection of five detachable drive units to give speeds from 1 to 48 pictures per second. Ranges as follows: 1 to 2 p.p.s.; 4 to 8 p.p.s.; 12 to 24 p.p.s.; 24 to 48 p.p.s. Also available: Remote-controlled single picture unit to give single random exposures, or for operation from intervalometer. **Magazines:** 200 ft. capacity, sufficient for 3,200 exposures, and 400 ft. (6,400 exposures). **Exposure Times:** From 1/50 to less than 1/1500 second. **Shutter:** Rotating segment type, variable in 10° increments from 150° to 10° shutter aperture. **Lens:** Almost any focal length supplied, each lens in individual focusing mount on instantly detachable slide. **Film Transport Mechanism:** "Beater" type. Sturdy and reliable. No claw or register-pins. **Weight:** 13 lb. complete. **Size:** 11 in. x 8 in. x 8 in.



Light Instrumentation Camera

H. S. 300 Camera

HIGH-SPEED CINEMATOGRAPHY

Application: The analysis of high-speed phenomena by photography at speeds up to 275 full-frame cine-quality pictures per second. Used extensively on guided weapon research.

Brief Specification: Motor-driven from 24-volt battery. **Speeds:** From 24 to 275 pictures per second. Range covered by two interchangeable motors. **Exposure Times:** From 1/50th to 1/10,000th second. **Lenses:** Matched pairs (viewing and taking) from 1¼ in. focal length to 36 in. **Magazines:** 400 ft. capacity quick-release type. Gear-driven take-up, scratch-proof light traps. **Film Transport Mechanism:** Special ultra-rigid counter-balanced design. Reciprocating claw and register pins engaging four perforations, ensuring complete steadiness. Claw motion retractable for ease of loading. **Shutter:** Half-speed type, adjustable from 170° to 10° in 10° steps. **Time Base:** High tension spark on edge of film from 50 cycles per second tuning fork. **Fittings:** Oil-pressure gauge, tachometer, footage-counter. **Film:** 35 mm.

Distributing agents for Vinten equipment outside U.K.

Cinematograph Export Ltd., 715 North Circular Rd., N.W.2.

CANADA: FEDERAL CINE-PHOTO PRODUCTS LTD., 134 QUEEN ST., OTTAWA, ONTARIO
S. AFRICA: F. F. W. HALL & CO., P.O. BOX 9138, JOHANNESBURG
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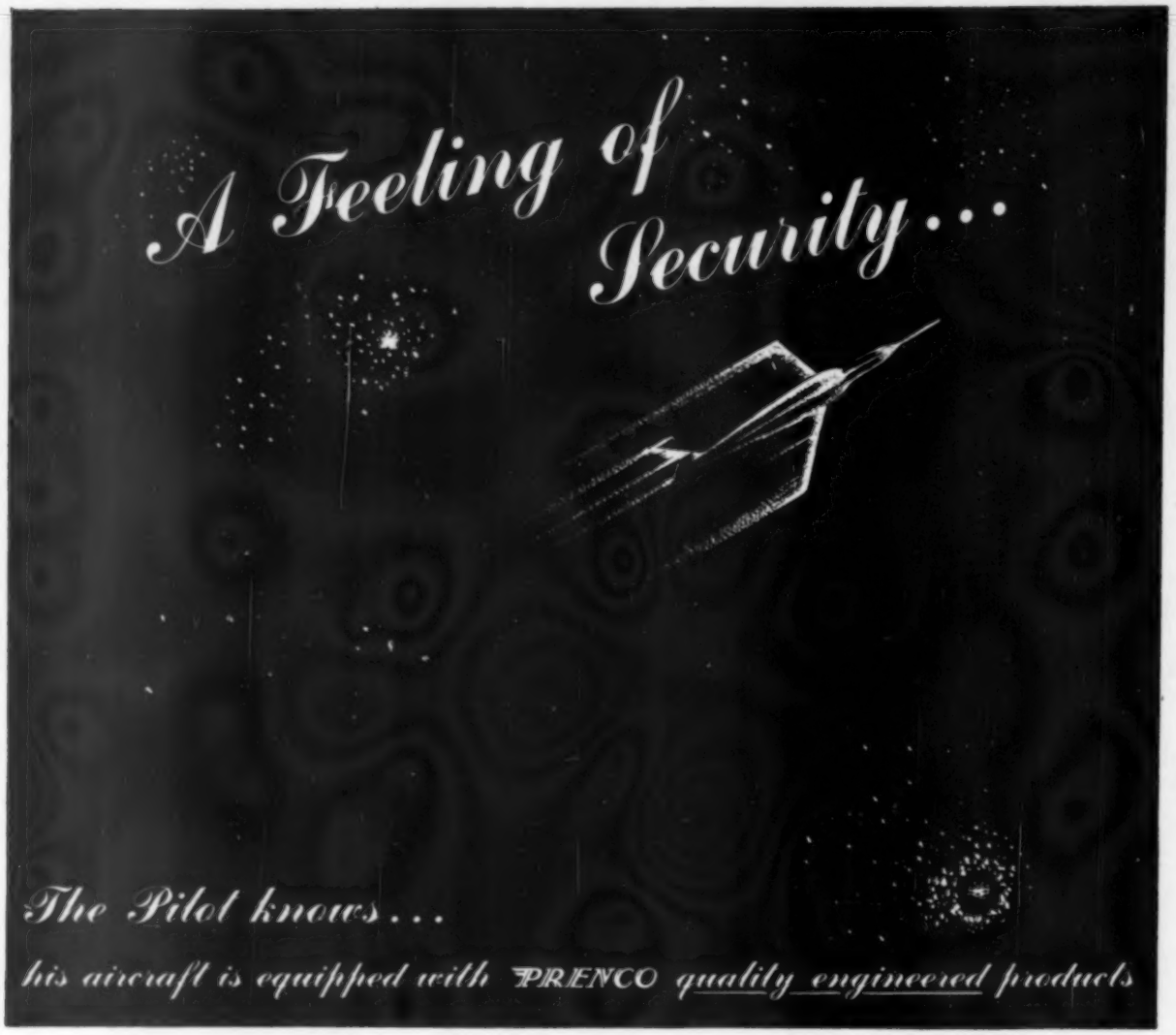

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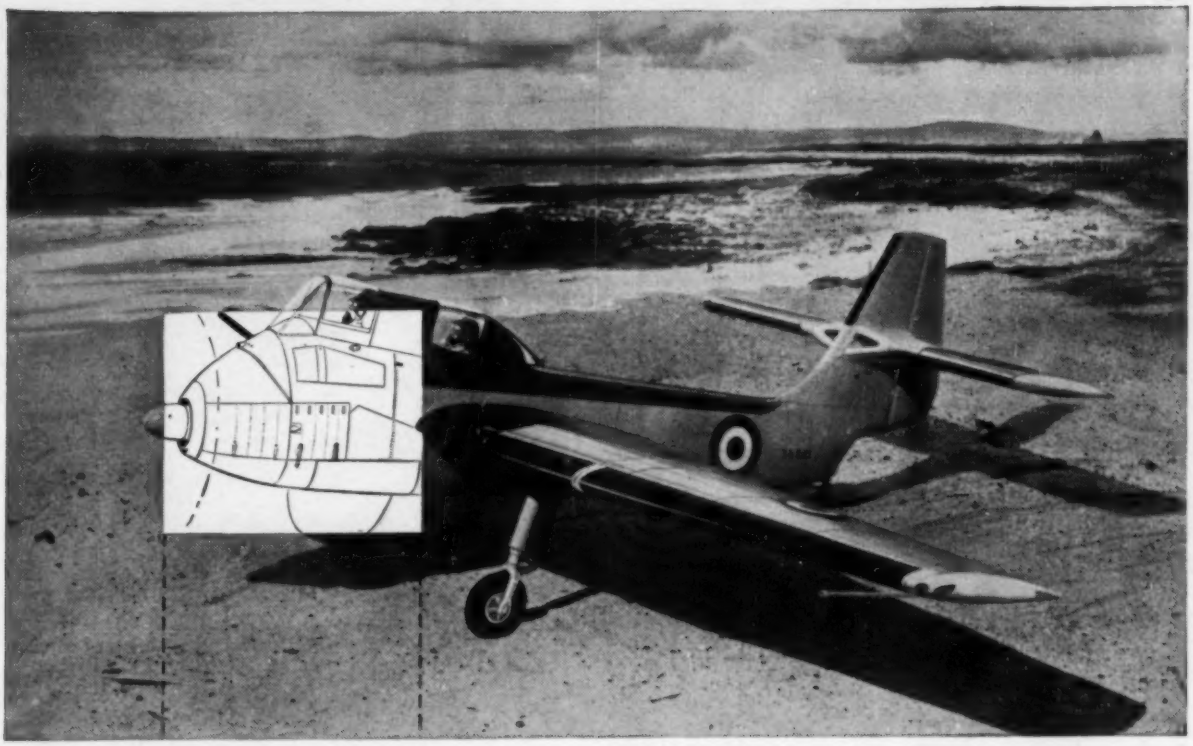
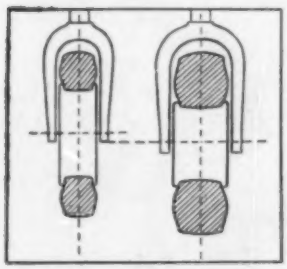
Sand strip – *Seamew* base



Simplicity of design ensures simplicity of maintenance—and economy in initial cost and in use of spares and manpower. Removable panels make components easily accessible.



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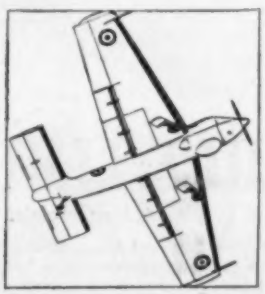

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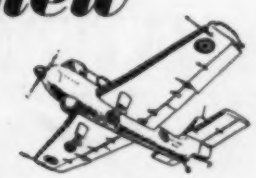

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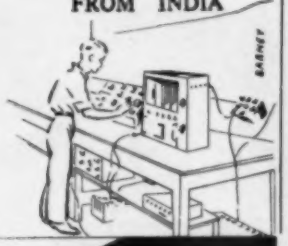

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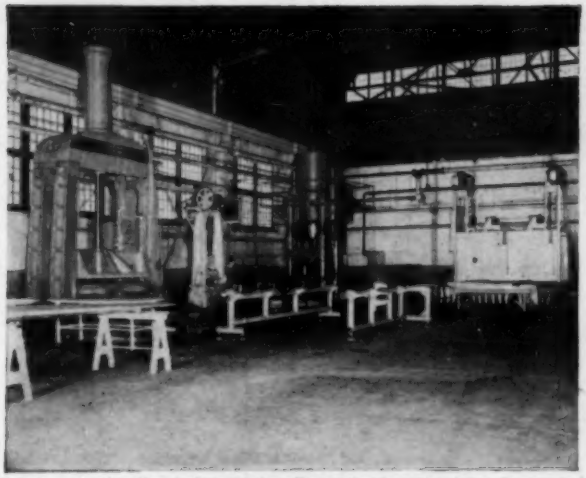
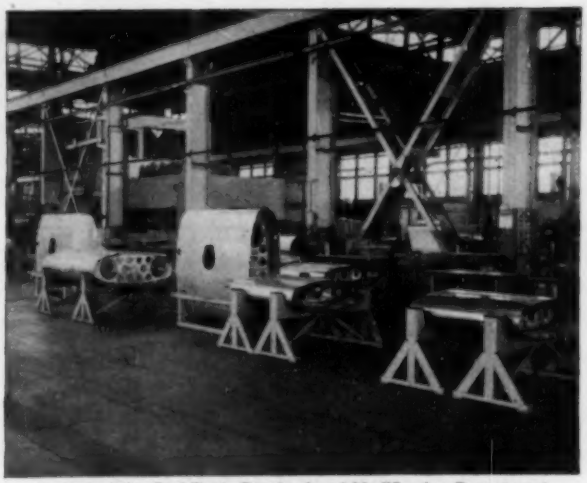
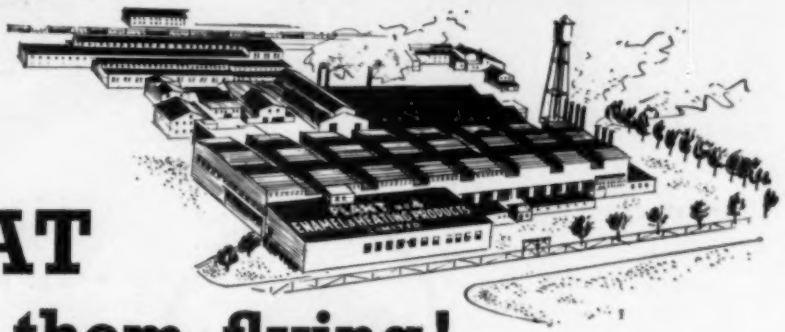


Section of the Metal Fabrication Shop showing the drop hammers, 2,000 ton hydraulic press and heat treating furnace.



Section of the Fuel Tank Overhaul and Modification Department.



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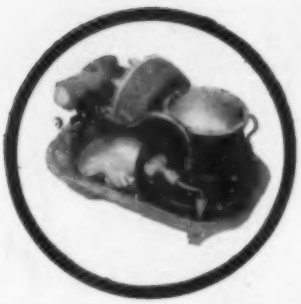

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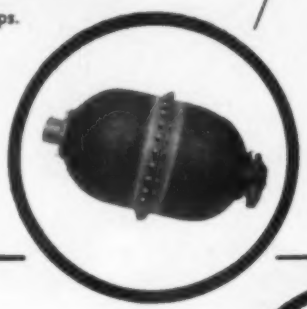

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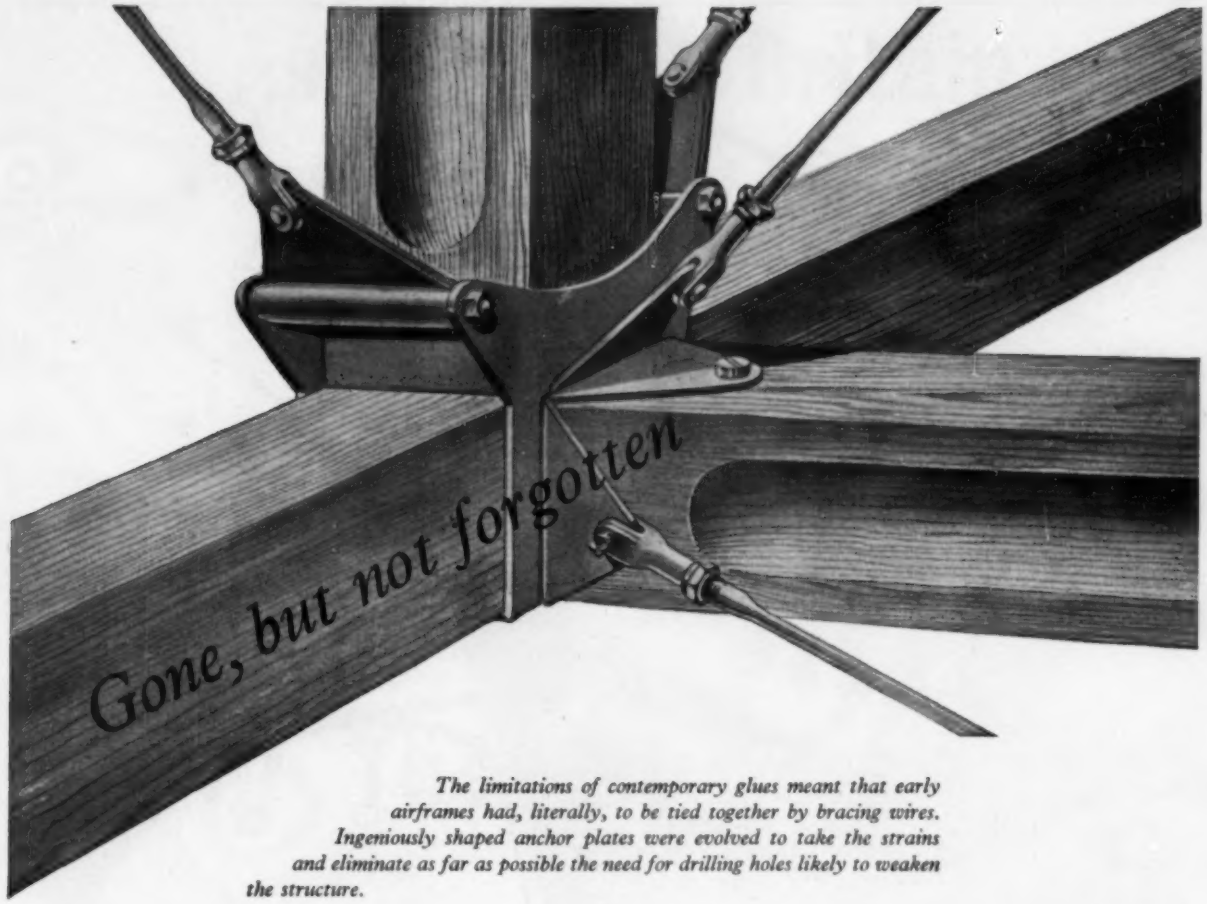

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★ *To be exhibited at the S.B.A.C. Exhibition, Farnborough, 1954, on Stand No. 124*

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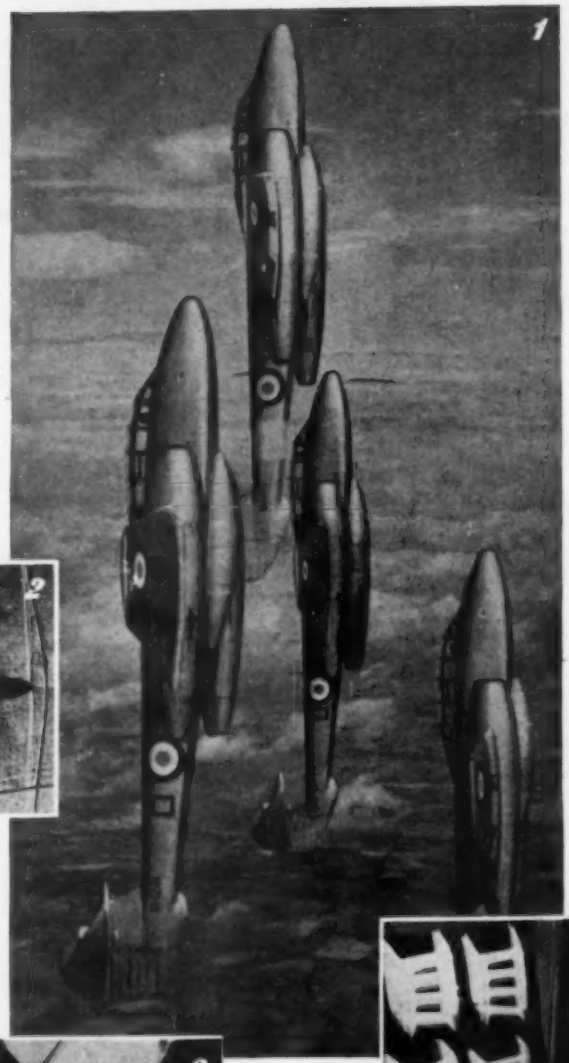

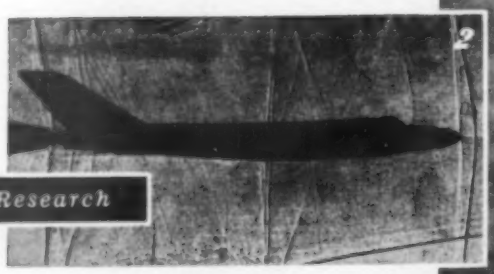

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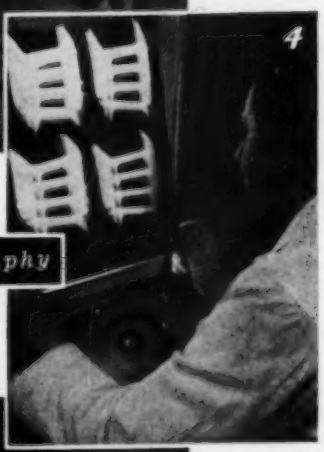
In research and development, in design and production, photographic methods play a vital part—and in all these fields, the aircraft industry relies more and more on Ilford photographic materials.



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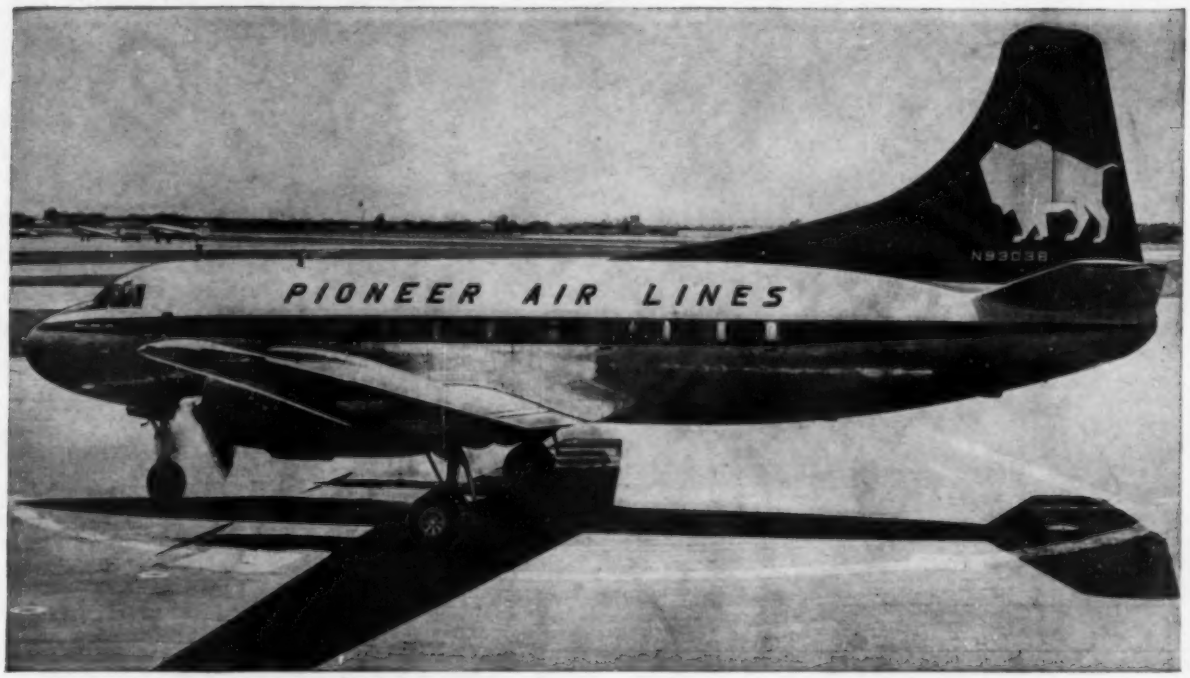

MARTIN 202

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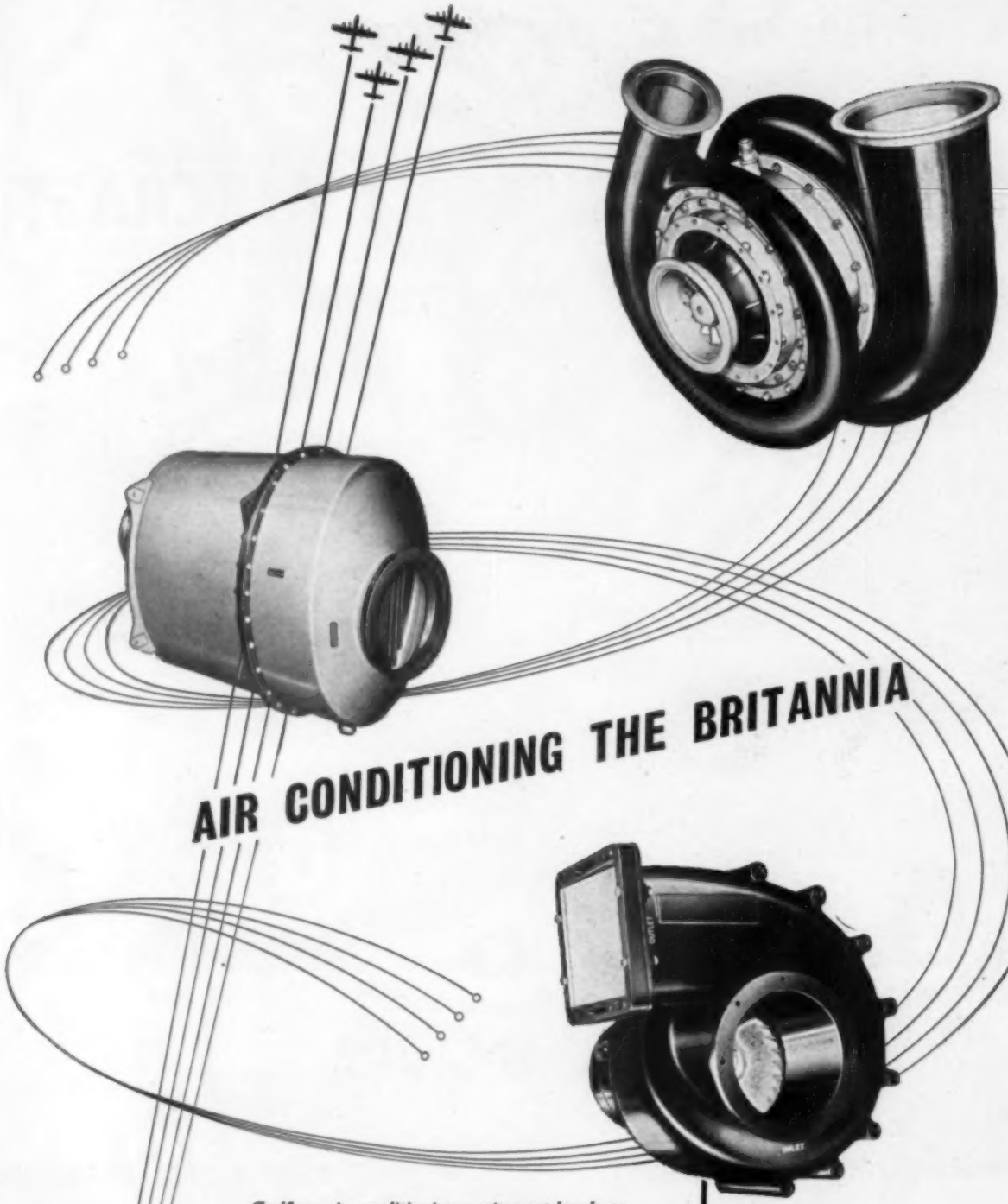

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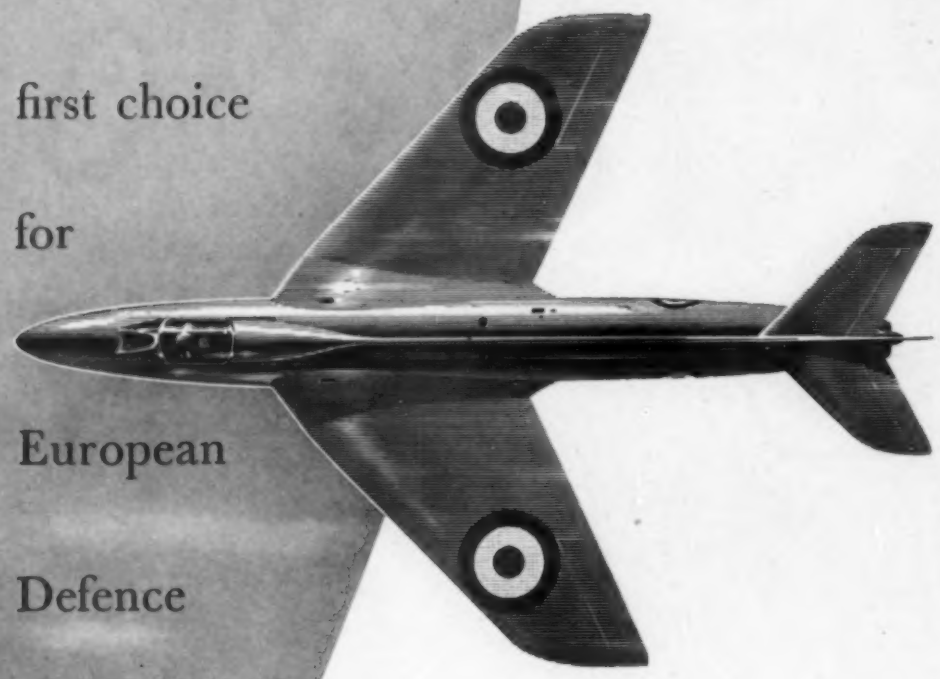
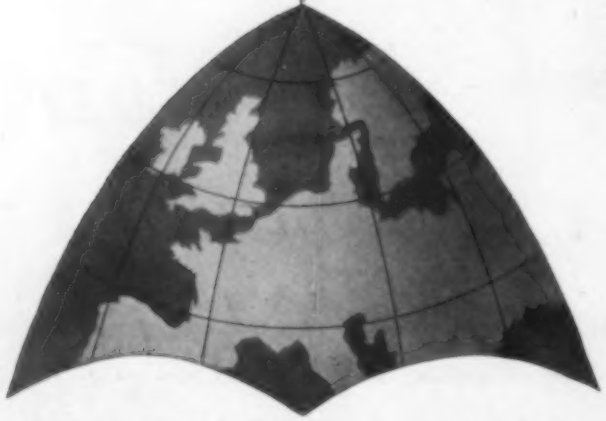


Not only has the Hunter proved itself in the air with its supersonic speed, its astonishing manoeuvrability and its imposing armament load, but it is proving itself in the markets of the world. First deliveries have now been made to the R.A.F. to fill Super-Priority orders, and it holds the largest U.S. off-shore aircraft order yet placed for N.A.T.O.—an order valued at $182,000,000. Big independent orders have also been placed for the Dutch and Belgian Airforces and recently the Swedish government placed an order worth £12,000,000 and the Danish government placed another order valued at £3,000,000. The majority will be delivered within the next two years. This great fighter—a fighter in the true Hawker tradition—will be a strong factor in the safety of the whole free world for a long time to come.



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Strength in Depth

WITH this special number of *Flight*, the first ever to be devoted to the subject, we introduce the aircraft manufacturers of the British Commonwealth countries. In the past, references have regularly been made to the overseas operators and to the products of individual manufacturers; in the pages which follow are collected together concise accounts of the background—going back in some cases to the 1920s—and the activities today of the Australian, Canadian and Indian aircraft and engine constructors and of many of the flourishing ancillary companies which support them. In addition, reference is made to the Air Forces and airlines of all the Commonwealth countries.

That this Commonwealth "special" should appear one week before our Britain's Aircraft Industry number and the S.B.A.C. Display and Exhibition itself is no coincidence; it has been our intention to complete the picture in the two issues, and to offer a "Farnborough on paper" on behalf of the Commonwealth manufacturers, of whom only a few will be represented at the world's greatest air show.

It is probable that the majority of our readers will be astonished at the extent and scope of the Canadian and Australian aircraft productive effort. Others who have been fortunate enough to visit those countries and see something of their aviation activities may still be surprised when they see all the main firms "on parade" together.

We ourselves confess to have been taken back a little as we became better acquainted with company after company and learned more of their facilities and diverse products. The expansion—since the war as well as during it—has been nothing short of remarkable.

To what does all this add up, and where is it leading? The easy-going British way of life, itself more eloquent than any speech in confirming our peaceable intentions is by no means a sign of weakness. There have been times in the past when the Commonwealth countries have been in grave danger, and there have been occasions, too, when bellicose nations have under-estimated the strength and determination of the British Commonwealth. These things could happen again and under very different circumstances and conditions than in the past.

The first aim, therefore, in both Canada and Australia—as is made amply clear in the accounts which follow—is to become self-sufficient in the provision of military aircraft. This has not yet been achieved, but both countries are perhaps half-way towards their goal. If they can get so far in peacetime, the records of the last war show clearly the sort of expansion that can be achieved in an emergency. The figures for wartime production of aircraft (both rate and numbers) quoted for almost all the companies will, we believe, be another source of surprise to many readers, even so long after the event.

Neither Canada nor Australia has a large population and thus the biggest single difficulty is to find the money to support a sizeable and flourishing aircraft industry and a powerful Air Force. Sensible as the conception of self sufficiency undoubtedly is, it does add to the cost of aircraft when only small numbers and low rates of production are required. This is the price of insurance, and it remains to be seen whether the premium will be too high when, as is becoming the case, bombers cost more than £1m each and fighters £¼m.

Both Canada and Australia are at this minute trying to decide what shall follow their respective variants of the Sabre fighter. While Canada has chosen Avro CF-105s eventually to replace the CF-100, Australia also seeks a successor to the Canberra. Canada apparently has no medium-bomber plans.

It is natural that Canada should work in close co-operation with the great ally across the border, but it will not be to the exclusion of her ties with the home country. Many of her most flourishing aviation organisations are daughter companies or partners of British concerns. The same is true of those in Australia.

It is in turn a comfort for us to know that, should these islands ever suffer atomic attack, great industries abroad to which some of the best British brains and hands have been dispersed would be ready again to take over with materials as well as men at any point where help were needed.

A. AND A.E.E.: A de Havilland Venom F.B.4 fighter/bomber taxies in at the Aeroplane and Armament Experimental Establishment, Boscombe Down (see paragraph on this page), past a Hawker Hunter F.1 (foreground) and a Supermarine Swift F.4. The imposing new building is known as the "Weighbridge Hangar"—a reminder that much of Boscombe's work of testing and evaluation is done on the ground.

FROM ALL QUARTERS

The Work of Boscombe Down

FOR the first time since World War 2 members of the Press have been allowed to visit the Ministry of Supply's Aeroplane and Armament Experimental Establishment at Boscombe Down in Wiltshire, though *Flight* was privileged to visit the Establishment shortly after the war. During this latest visit it was possible to observe the work of testing and evaluation of new Service aircraft fairly closely, despite the fact that most of the details of such activities are of necessity covered by strict security regulations.

A full demonstration was prepared to illustrate the work undertaken. The briefing and post-flight debriefing of a pilot testing the effects of the powered ailerons of the Venom F.B.4 were made in public, the hood jettisoning sequence of a Vulcan was shown with the aid of the open-ended blower tunnel, and a number of aircraft gave demonstrations of mirror deck-landing, parachute supply dropping, helicopter troop assault landing, and finally, air-to-ground rocket, machine-gun and cannon firing. In this last display, on the Imber range, the Aden 30-mm gun was fired in public for the first time; it was demonstrated from two aircraft, a Swift I and Hunter I.

In addition to the flying and open air activities, an extensive static display showed the numerous tasks carried out by the engineers and scientists who direct and support the aerial tests, record and interpret results, and carry out the technical evaluation of all the various items of equipment which go to make up what is now called the weapons system. The modern fighting aircraft must be regarded as a weapons system, an integrated fighting machine designed from the start to perform a specific task, and it is the object of A. and A.E.E. to prove every section of the system so that the equipment is capable of fulfilling its task in service. A detailed description of the Establishment's work will appear in a future issue.

For Navigation and Reliability

THE winner of the 4,000-mile aircraft trial sponsored recently in Australia by the Redex company was W. Murrell, of Hillston, N.S.W., flying an Auster Aiglet Trainer. Starting and finishing at Bankstown Airport, Sydney, the course circled half the Australian continent and followed the route of the 1953 car trial organized by the same company. Mr. Murrell, who received £1,000 and the Redex Trophy, was the only competitor to complete the course without loss of marks. Second was an Auster Autocar (pilot Buckley) and third a Tiger Moth (pilot, Shipp).

The contest—officially known as the Redex Aircraft (Navigation and Reliability) Trial 1954—was open to aircraft of all-up weight not exceeding 12,500 lb, and the machines entered included a Mustang and an Anson.

K.L.M. and Braniff Accidents

ON August 23rd a DC-6B of K.L.M., PH-DFO *Willem Bontekoe*, descended into the North Sea some 17 miles north-west of the Dutch coast with the loss of all 12 passengers and nine crew. The aircraft was completing a flight from New York to Schipol *via* Shannon; the cause of the accident is unknown at the time of going to press. A 15-year safety record was broken on August 22nd, when a Braniff International Airways DC-3 crashed in a hailstorm at Mason City, Iowa, with the loss of 11 of the 19 people aboard.

New French Attaché

COLONEL A. J. B. PUGET succeeds Col. H. de Rancourt, C.B.E., D.F.C., A.F.C., as Air Attaché to the French Embassy in London on September 5th. Col. Puget, who was at St. Cyr, was in the latter part of the war with the French Squadron 343-344 and officer commanding at Elvington. In 1948 he became personal assistant to the Chief of Staff, General Lecheres, and in the following year was appointed Chief of Staff, French Air Force, in Morocco. Then, following a period at the Armed Forces Staff College, Norfolk, U.S.A., he has been, until his new appointment, in A.A.F.C.E. (Fontainebleau). Col. Puget is a Commander of the Legion of Honour, and was awarded the Croix de Guerre. His decorations also include the British D.S.O. and the American Air Medal.

Gannet Trainer Flies

DESIGNED to give full operational training in all aspects of the anti-submarine work for which the Fairey Gannet A.S.1 is intended, the Gannet T.2 trainer, which first flew on August 16th, is among new developments scheduled to appear at the S.B.A.C. Display. Principally it will afford advanced training in the use of weapons and in engine handling. The design provides for the pupil to occupy the foremost seat, with the instructor in No. 2 cockpit, wherein all pilot controls are fully duplicated. The instructor's view from No. 2 cockpit (which, in the A.S.1 version, is normally occupied by the observer/navigator), is claimed to be "exceptional" in forward and downward directions. The new Gannet can also be used as a communications machine, No. 3 cockpit having been adapted to carry either a radio operator or two passengers.

It has been made known also that a Gannet A.S.1 has been evaluated in Canada by the Royal Canadian Navy, and that the type has successfully passed "stringent operational tests."

Canberras on the Continent

UNDER arrangements agreed with Supreme Allied Commander Europe for co-operation between R.A.F. Bomber Command and Air Forces on the Continent, No. 149 Squadron, equipped with Canberras, will shortly leave the U.K. to be based at Ahlhorn in Germany. The squadron is commanded by S/L. R. E. R. Adams. Under the same policy other Canberra units will be stationed in Germany from time to time; and Canberra squadrons for P.R. and other duties will be formed later as part of 2nd T.A.F.

Viscounts for Airwork

AN order for three Vickers-Armstrongs Viscounts has been placed by Airwork, Ltd., bringing the number of Viscounts definitely ordered to 146. The aircraft will be delivered in the first half of 1956, and will be of the developed Series 700D type, with Dart R.Da 6 turboprops. Airwork thus becomes the second British independent operator to order turbine-powered airliners (Hunting-Clan Air Transport, Ltd., expect delivery of three Viscounts in February-April next year). The routes on which Airwork's Viscounts will operate have not yet been announced.

Ground Radar for L.A.P.

THE present system of directing aircraft on the ground at London Airport is based on visual supervision from the control tower coupled with R/T. position-reporting by aircraft. This system, say the Ministry of Transport and Civil Aviation, will have to be augmented if the increasing traffic at L.A.P. is to flow smoothly in bad weather. Accordingly, the new central control tower is to be equipped with an A.S.M.I. (airfield surface movement indicator). For this purpose, the M.T.C.A. have chosen the Decca Millimetric Radar, "because of its good general picture quality with sharp delineation of runways and taxiways and its high discrimination."

DC-7s for South Africa

AN order for three Douglas DC-7s, at a cost of £700,000 each, was announced by South African Airways on Monday. Intended for use between Johannesburg and London, the new aircraft will be delivered early in 1956.

Farnborough Forecast

THE news, released last week, that the English Electric P.1 supersonic intercepter will not be allowed to appear at the Society of British Aircraft Constructors' Display (September 7th-12th) was dismal indeed. There will, nevertheless, be the Supermarine 525—another fighter with a terrific performance—and the fascinating Folland Midge, together with advanced versions of established types. As we go to press, the picture—first of aircraft (including flying test-beds) and then of engines—presents itself as follows:—

Armstrong Whitworth.—A Meteor N.F.14, a Hunter F.2 and a Sea Hawk make up this year's "A.W." contingent. All will fly.

Armstrong Siddeley.—The reheat-Sapphire Canberra may be joined by a second Canberra with a Viper on one wing-tip.

Auster.—The A.O.P.9 and a version of the Aiglet Trainer, with Gipsy Major 10, will both be there.

Blackburn and General.—The Beverley will be at home to visitors in the static park, but will not take the air this year. A model will be a reminder that two Folland Gnats can be carried.

Boulton Paul.—A Balliol T.2—registered G-ANSF—has been acquired by the company for demonstration purposes and will fly.

Bristol.—The largest aircraft to fly will be the Britannia—first of the production-type Mk 100s. On the 9th—the "civil" day—it may be joined by a Silver City Mk 32 Freighter. Bristol-operated flying test-beds—both to be flown—will be the Ambassador with Proteus 705s and the Olympus-Canberra. The company's helicopter activities will be typified by the Type 173 Mk 2 (without stub wings this year) and a Sycamore Mk 4. In the static park will be one of the new Sycamore Mk 14s for the R.A.F.

de Havilland.—In the flying display will be a Comet 2, Comet 3, Heron 2 (executive), Beaver 2, and D.H.110. Statically displayed will be a Dove 6 (executive), Chipmunk, Venom N.F.3, Venom F.B.4, Sea Venom N.F.21, and Vampire Trainer.

English Electric.—The P.1 supersonic fighter having been barred from appearing, English Electric will be represented by examples of the Canberra B.6, P.R.7 and B.8.

Fairey.—The F.D.1 delta-wing research aircraft and Gannet T.2 trainer will give individual displays, and a Gannet A.S.1 will fly in a "circus." Additionally it is hoped to have a second A.S.1 and a Firefly 8 in the static park.

Folland.—The Midge light fighter prototype will be flying (in a delightful manner, from all accounts), and in the static exhibition will be a fully equipped Midge front fuselage, a working model of the Gnat's "flying" tailplane, a demonstration panel of a special rocket release system, and comparisons between the equipment and fire power of the Gnat and a "standard fighter."

Gloster.—For the first time since the war no Meteor will take part in the flying display, though the P.V. 7/8 two-seater will be statically shown. In the air Glosters will be very strongly represented by five Javelin FAW.1 delta-wing all-weather fighters.

Handley Page.—It is hoped that the second prototype Victor will put in an appearance; but, either way, H.P.s are likely to have plenty to say and show concerning their Dakota replacement.

Hawker.—There are hopes that something new will be forthcoming from the Kingston works by way of Dunsfold. In any case, there will be a production-type Hunter F.1.

Hunting Percival.—A highlight this year will be the Jet Provost trainer, supported by a standard Provost T.1, an armed Provost T.53, and a Pembroke.

Napier.—Having been flying with one Bristol Hercules and one Napier Eland turboprop, the Vickers Varsity operated by D. Napier and Son is now being fitted with two Elands and will fly at Farnborough with these units, if ready in time.

A. V. Roe.—The Vulcan prototype VX770, with four Armstrong Siddeley Sapphires, will demonstrate. Though the first Shackleton M.R.3 will not be ready for exhibition, an M.R.2 will be available for inspection in the static park.

Rolls-Royce.—At least one turbojet test-bed will be coming down from Hucknall.

Saunders-Roe.—The Skeeter helicopter will be flying.

Scottish Aviation.—Although it had been intended to show the Twin Pioneer, the first example will not be completed in time, due to the fact that it is being built to a large extent on production tooling. A Pioneer 2 will keep the Scottish flag flying.

Short and Harland.—Shorts are represented this year by three types—the Seamew A.S.1 and Sherpa, which will fly, and the S.B.5, which will not.

Vickers-Armstrongs.—The Valiant B.2 bomber and the second Viscount for Trans Australia Airlines will be flown, and there will be a Viscount in the static park.

Vickers-Supermarine.—In addition to a production-type Swift F.4 there will be the twin-Avon Type 525 Naval fighter.

Westland.—A Westland Whirlwind (S-55) helicopter will be there in Naval colours and fitted with an Alvis Leonides Major engine. On the Westland stand will be the cabin structure of an S-55 fitted with passenger seats and cabin furnishings to B.E.A. requirements for the London Airport-South Bank service.

Alvis.—In addition to a standard Leonides or Leonides helicopter power-plant, there will be a Leonides Major and a similar type of engine developed for helicopter work.

Armstrong Siddeley.—The Sapphire to be shown will be an ASSa6; additionally there will be a Double Mamba, a Viper 101, a Mamba and a Snarler.

Blackburn and General (Engine Division).—Four Turboméca units (two redesigned to meet British requirements) will be on view, together with a Bombardier.

Bristol.—The company's engine division will be showing an Olympus, a Proteus 705, and a Centaurus 661.

de Havilland Engine Co. will show a Gipsy Queen 30 Mk 2 (Heron engine) and a Super Sprite rocket pack.

Napier.—The Oryx gas generator will be making its first appearance. Additionally there will be an Eland and a Nomad.

Rolls-Royce.—Having by far the best power/weight ratio of any turbojet developed to date, the new Soar will be a major attraction. A late-mark Avon will be there, together with a Dart 510.

THE SOAR: OUTSTANDING NEW ROLLS-ROYCE TURBOJET

THE great Rolls-Royce organization has this week been permitted to reveal the existence of a completely new axial-flow turbojet, which has been, and remains, under intensive development. In conformity with the policy of naming Rolls-Royce gas turbines after British rivers, the new unit is known as the Soar, after the river of that name in Leicestershire.

This particular Soar is shown without its intake. It is evidently a basically simple engine, and seems to be made largely of sheet rather than of heavy castings. Pipes and suspension lie along the top.

Very little can yet be said about this engine, but much can be surmised. The dominating fact which fairly leaps from the brief table of data (p. 260) is that the Soar develops more power per pound of weight and more thrust per unit of frontal area than any other turbojet for which figures have been published. Generally speaking, the larger the engine the better will be the thrust/frontal area; again, if an engine is merely an expendable unit for missiles it is fairly easy to achieve a very high value for thrust/weight. The Soar is not a large engine, and neither is it necessarily a short-life unit, yet—as our diagram shows—it sets completely new standards in output from a given compass.

It is an axial-flow turbojet, apparently with an annular combustion chamber. Installation in an airframe should be very simple, owing to the clean exterior and grouping of service lines

It requires a diagram of the type shown on the right to illustrate graphically just what a great achievement is the new Soar axial turbojet. Even if we had included foreign engines, no other turbojet could approach it.

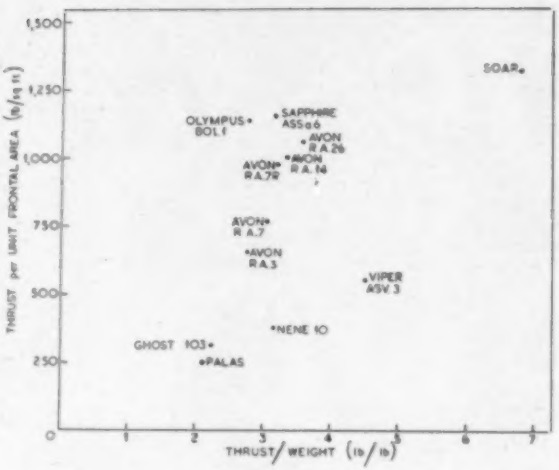
THE ROLLS-ROYCE SOAR . . .

along the top of the casing. The engine appears to be slung (in the example shown) from a large welded saddle-bracket, with a steadying attachment at the front. Readers may like to ponder on the layout of the Soar beneath the smooth casing, with its serried rows of bolts, rivets and roll-welds.

Installed, much depends on what form of intake is fitted. A typical intake for the Soar weighs about 8 lb, and the intake used during the M.o.S. type test resulted in an "official" thrust of 1,860 lb; Rolls-Royce, however, are quoting a rated value of 1,810 lb, which is obtained by another typical intake.

No hint can be given of the uses to which the Soar will be put; we can only say that its applications are numerous and varied. Engines of the Soar family are in production, and the unit is scheduled to make its first public appearance at the forthcoming S.B.A.C. Flying Display and Exhibition.

ROLLS-ROYCE SOAR at RSr.2 rating. Overall diameter, 15¾in; length as shown in photograph, 62¾in; dry weight, 267 lb; frontal area, about 1.365 sq ft; typical static thrust, 1,810 lb (Ministry of Supply type-test figure, 1,860 lb); thrust per pound of dry weight, 6.78 lb; thrust per square foot of frontal area, 1,326 lb; typical specific fuel consumption, 1.26 lb/hr/lb thrust.



CORRESPONDENCE

The Editor of "Flight" does not hold himself responsible for the views expressed by correspondents in these columns; the names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

Support for the Clubs

I REFER to the letter from the secretary of the Association of British Aero Clubs and Centres published in your issue of August 13th.

In that letter it is stated "my Council are aware of only one case during the last eighteen months in which clubs have benefited from the Trust in the manner indicated (the acquisition of aircraft and equipment on a long term basis) and can call to mind only five instances of our member clubs having been so assisted since the Trust was formed in 1947."

According to the records of the Kemsley Flying Trust the number of light aeroplane clubs assisted on the basis mentioned in the last eighteen months is five, of which two have received more than one loan in the period.

Since the formation of the Trust the number of light aeroplane clubs assisted is fourteen, of which four have received loans on two or more occasions. There have been a further eighteen loans to light aeroplane groups which are not registered as clubs.

Manchester, 4. B. A. G. MEADS,
Secretary, The Kemsley Flying Trust.

High Potential

I AM bold enough to believe that I can better your suggested names for the P.1. How about calling it the "English Electric Shock"?

Bridport. NORMAN JENKS.

First World War Aircraft

HAVING followed with great interest the articles on First World War aircraft which have appeared in *Flight* from time to time with special reference to the Avro 504, I felt I must add a note to Mr. Derrick G. Beeton's letter published in your issue of August 6th. I regret the delay in reading it for which I plead participation in the Royal Danish Aero Club Rally.

I note Mr. Beeton gives his address as Leeds, so he should be interested to know that the Yorkshire Aeroplane Club owned and operated a 504 with a Renault engine in 1927. My log book entry quotes only the last two registration letters "IU". Unfortunately, it was pranged on take-off due to overloading in an endeavour to supply the London hotels with too many grouse in one load. The stable companions to the old Avro were two Moths, EBLS and EBNN.

In the same issue I was amused at Mr. A. L. Winter's description of the D.H.6 as "The Sky Hook." Yes, I remember. Many hours have I been "Hooked," and little did I think I should still be at it—this time in a Gemini G-ALUG affectionately known as Uncle George.

Sherburn-in-Elmet, Yorks. ARNOLD G. WILSON.
Director, Yorkshire Aeroplane Club.

Histories of Nos. 20 and 27 Squadrons?

READING the request in *Flight* of July 2nd of F/O. Huxley, Adjutant of 28 Sqn. for material for his scrapbook history of the unit, made me wonder if anyone had tackled a similar task for 20 or 27 Sqn.

I served three years with 20 Sqn. at Peshawar and Kohat, on the North West Frontier of India (as it then was), before being transferred to 27 Sqn. to join in their adventures in Malaya and Singapore.

I wonder if any member of the rear party of 27 Sqn., at the time of the fall of Singapore, remembers the name of the little ship on which we made the somewhat perilous journey to Batavia. As far as I can remember it was named after a Malayan river or island.

I would be only too pleased to co-operate if the adjutant of either 20 or 27 Sqn., or any other interested party, were to take on the task of compiling a squadron scrapbook.

Montreal Airport, Quebec, Canada. M. MACDOUGALL,
Telecommunication Laboratory,
Trans-Canada Air Lines.

FORTHCOMING EVENTS

Aug. 28. Southern Aero Club: Goodyear Trophy Race, Shoreham.
Aug. 18-28. "Model Engineer" Exhibition, London.
Aug. 29. Yeadon Aero Club: "At Home."
Aug. 29. R.A.F. Gliding School, Kenley: "Open Day" and flying display.
Aug. 29-30. Pescara Aero Club: Annunzio Trophy contest, Pescara, Italy.
Sept. 5. Saar Aero Club: Europa-Pokal display.
Sept. 6. Society of Licensed Aircraft Engineers: "Medical Aspects of Aircraft Engineering," by W/C. F. Latham, M.D., B.Sc., Ch.B. (at R.A.E., Farnborough).
Sept. 7-12. S.B.A.C. Farnborough Display and Exhibition ("Public" days, 10th, 11th and 12th).
Sept. 9. Helicopter Association: "Helicopter Contracting," by Knute Flint. (Followed by annual dinner.)
Sept. 9-12. Royal Aero Club: International invitation air rally, White Waltham.
Sept. 13-19. Battle of Britain Week.
Sept. 16-17. Aerodrome Owners' Association: Annual Conference, Northampton and Sywell.
Sept. 18. R.A.F. "At Home" Day.
Sept. 25-26. Aero Club of Germany: Hanseatenflug international rally.
Sept. 20-29. Fédération Aéronautique Internationale: 47th annual general conference, Istanbul.
Sept. 29. British Institution of Radio Engineers: "Computing Circuits in Flight Simulators," by A. E. Cutler, B.Sc., Ph.D.
Oct. 11. Institute of Transport: Presidential address by Sir Gilmour Jenkins, K.C.B., K.B.E., M.C., M.Inst.T.
Oct. 15. Rochester Flying Club: Annual dinner and dance, Bearsted.
Oct. 15. Helicopter Association: "Application of Gas Turbines to Helicopter Propulsion," by J. Brown.
Oct. 15. The Airlines Ball, Royal Albert Hall, London, 8 p.m.-2 a.m.

Fifth International Astronautical Congress

Flying at Mach 14: Two-year Trips Round Mars: Meteorite Bumper Screens

By ERIC BURGESS, F.R.Ae.S.

TO the tune of rumours that the Russians had sent a guided missile around the moon and a statement by Dr. Walter Dornberger that the United States were developing a rocket plane capable of flying at Mach 14, the International Astronautical Congress got off to a flying start at Innsbruck. Although the British delegation was much smaller than usual, the number of Americans showed a decided increase and the prominent figures of European rocketry attended *en masse*. Mr. F. C. Durant III, of Washington, a past-president of the American Rocket Society, was again elected to continue in office as president of the International Federation.

A. J. Zaehringer, of the Grand Central Aircraft Co. Rocket Division, was enthusiastic about solid-propellant rockets. He pointed out that so far most discussions concerning astronautical problems have been confined to liquid propellants, whereas he contended that solids could be usefully employed for certain astronautical operations. The characteristics of this type of rocket are a high total impulse/total rocket weight ratio, high reliability of operation, and a tendency towards lower costs than liquid-propellant rockets. Unfortunately, the specific impulses are much lower, 180-200 compared with 240 secs, but the failure rate is only one in 10^4 to 10^6.

It was suggested that a solid-propellant high-altitude rocket with the impulse of the Viking (cost £200,000) could be constructed for as little as £25,000. It would be a three-stage vehicle capable of being used for synoptic high-altitude work without incurring fantastic expenditure. Similarly, it was suggested that developments of solid-propellant rockets could be used as boosters in the early stages of space rockets. From extrapolations of techniques developed towards the end of World War I and present technical achievements in plastic and rubber technology, it was prophesied that single grains might be cast having 1,000,000 lb-sec impulse.

Little was said at the congress concerning conventional liquid-propellant rockets. Security restrictions probably saw to that. But H. H. Koelle, of Stuttgart, suggested that a 2-stage Curtis turbine is the best solution for turbo-pumps which have to operate for periods of 100 seconds. For operating times approaching one hour, which may be the case in space ships, he stated that multi-stage gear turbines are superior to all other types. From Holland, M. Vertregt read a paper aimed at the standardization of mass ratios for step rockets. He defined three ratios which are sufficient for all basic calculations and which always have a value greater than unity, thus giving derived equations which are simple and symmetrical.

Looking more into the future, two papers analysed possibilities of electrical methods of space ship propulsion. Darrel C. Romick, of the U.S.A., developed a number of basic design principles for reaction-powered space vessels. He showed that, for a given thrust, propellant consumption varies inversely with jet velocity, while power consumption goes up as the square of exhaust velocity. He proceeded to analyse an ion rocket system for deep-space work. A linear electronic accelerator for positively charged ions was postulated, working like a cyclotron but with the particles travelling in a straight line, receiving impulses as they pass alternately connected accelerating rings. An axial magnetic field would be used to prevent divergence of the beam, and a small electron gun would be needed to prevent a space charge building up. The system was designed to use N_2^{14} ions with an exit velocity of 10^7 feet/sec. The flow rate would be ·0023 lb/hr, the thrust ·19 lb. Major problems to be encountered in the design of such a unit were shown to be the large horse-power (1,000,000 ca.) in the generating equipment, high ion-current sources and beam divergence. A ship needed for a journey to Saturn was investigated. It was shown that the ship would have to start in space and that the greatest weight would consist of the atomic pile, screens and motors. A gross weight of 1,000 tons was assumed with a payload of 40 tons.

Another approach to this problem was made by E. Stuhlinger, of the Guided Missile Development Division, Redstone Arsenal. He dropped the idea of using a uranium pile for power and assumed collection of energy from the solar rays. A propulsion unit was proposed in which a suitable propellant (caesium or rubidium) would be vapourized and ionized at incandescent platinum surfaces. Ions and electrons would be accelerated and expelled at equal rates, recombining immediately after leaving the thrust chambers. He showed that a thermo-electric pile would be about ten times less efficient than turbo-electric generators for the same mass. Using this system an Earth/orbit-Mars/orbit ship would take a flight time of two years for a round trip and would have a mass of 270 tons.

So the papers led into intricate orbital theory. H. Preston-Thomas, of Ottawa, showed that ion rockets do not suffer from some of the limitations imposed by chemical rockets' high fuel consumptions. They allow the consideration of the use of non-minimal orbits on journeys to the inner planets and reasonable flight times in journeys to the outer planets. It was shown, nevetheless, that even with atomic-powered rockets having high characteristic velocities, there must still be long periods during which transfers between the Earth and Mars cannot be made. For a ship capable of reaching an outer planet like Neptune, extraordinary power requirements would prevail. One example needed 972,000 kw to maintain the ion beam compared with 16,800 kw for an ion rocket capable of journeying to Mars.

D. F. Lawden, of Birmingham, developed an important relationship concerning escape from a satellite orbit. He showed that it is economical in propellant consumption first to fall towards the centre of attraction, thereby building up velocity at the expense of potential energy. The thrust should not be tangential but should be thrown off at an angle away from the centre of attraction, an angle which must be reduced as the manœuvre proceeds and should become zero at the end of the thrusting period. This decreasing throw-off programme is closer to the optimum than the usual tangential thrust manœuvre which is generally described in the literature.

An analysis of orbital systems by K. A. Ehricke, of the Bell Aircraft Corporation, proved a valuable study of a minimum manned satellite vehicle project. He showed that a small satellite can be established capable of maintaining four men in space. This satellite differed from previous space station projects by having its mass concentrated at the centre. The paper also analysed the sizes of the vehicles needed for establishing the manned satellites and indicated how the programme might be organized. In addition, the various orbits which would be required for arrival and departure of interplanetary missions, and for lunar missions, were discussed in detail.

I. M. Levitt, of the Franklin Institute, prepared a paper which showed that even a small uninstrumented satellite would be well worth establishing. He reckoned that developments from present-day missiles could be made in the next four years or so which would permit the small satellite to be set up. Principally it would consist of an expandable sphere which would reflect radar and light waves. Observations of its orbit would enable geodesists to determine large distances over the surface of the earth, especially over bodies of water where triangulation is difficult, to determine the gravitational constant 'g' and to measure accurately the oblateness of the earth.

Gradually the papers moved round to that important aspect of all flight, the reactions of man himself. Dr. Hubertus Strughold, head of the Department of Space Medicine, U.S. School of Aviation Medicine, said that space flight is now a reality. Within the astronomically defined atmosphere, conditions are found which are physiologically equivalent to those existing in free interplanetary space. Those that occur at certain topographically fixed levels of the atmosphere are termed *static space equivalent conditions*. The state of zero-gravity as it is encountered in flight is termed a *dynamic space equivalent condition*. Since some of the biologically significant conditions are encountered in present manned rocket flight, Man has already been in space.

The flies in the interplanetary ointment seem to be meteorites and cosmic rays. Concerning the former, N. H. Langton's paper showed that meteorites could be thermally dissipated by special screens. Meteorites of magnitude fifteen might be encountered every 20 days or so but could be destroyed by a bumper thickness of 0·1 cm. On the other hand, protection of humans from the heavy nuclei of cosmic radiation beyond the atmosphere was shown, in a paper by H. J. Schaefer, to be impossible. Whether or not such radiation will be harmful cannot yet be assessed, but as any harmful effects will slowly develop, cosmic rays may be an insidious undramatical danger to crews on long interplanetary journeys.

It is gathered from the congress that Man will fairly soon make short hops into space in his new rocket planes and that missiles will also be probing beyond the atmosphere. How soon true interplanetary flight will follow is still a matter of conjecture. From the many known difficulties it would seem that the end of the century might still be a conservative estimate for a circumnavigation of the Moon.

HERE AND THERE

U.S.A.F. Squadron in Holland

IT was announced in Washington last week that the U.S. and Dutch Governments have signed an agreement under which a U.S.A.F. squadron of jet fighters will be stationed at Soesterberg, the air base lying just to the south of the Zuider Zee. The agreement concerns legal, financial and allied matters.

Stratotanker Deliveries—

DELIVERIES of the Boeing Stratotanker to the U.S.A.F. will begin within 18-20 months, according to an American report. The same source says that the production model may gross 60,000 lb more than the 190,000 lb prototype and that the 128ft fuselage may be "stretched" by as much as 30ft. The production engine will probably be the Pratt and Whitney J75, a larger turbojet than the J57.

—and a Hold-up

FOLLOWING brake trouble during a landing, the nosewheel unit of the Stratoliner/Stratotanker was badly damaged on August 5th. No spare parts had been built for the prototype and its intensive flight-test programme had to be suspended. The aircraft is expected to fly again within 30 days of the mishap.

London-Amsterdam Record

THE Royal Aero Club announces a revised speed for the London-Amsterdam record set up on July 29th by Lt. J. R. F. Overbury in a Sea Hawk F.B.3—571.5 m.p.h. instead of 568 m.p.h., as originally stated. This adjustment results from the discovery that the first figure was based on the equivalent flying time between the centre of London and Schiphol Airport, instead of the centre of Amsterdam.

JONAHS BY THE SCORE: Whale-like, the first Convair R3Y-2 transport flying-boat for the U.S. Navy rides at a San Diego floating dock ready to ingest 103 U.S. Marines. With its four Allison T40 turboprops, the R3Y-2—otherwise the Tradewind—is the fastest large flying-boat extant.

HERE TO STUDY B.E.A.'s Viscount operations is Capt. W. Sewell, chief test pilot of Capital Airlines, who have ordered 40 of these aircraft. On August 19th he flew to Lisbon on a scheduled Viscount service, spending some time on the flight-deck with Capt. D. Mason (right).

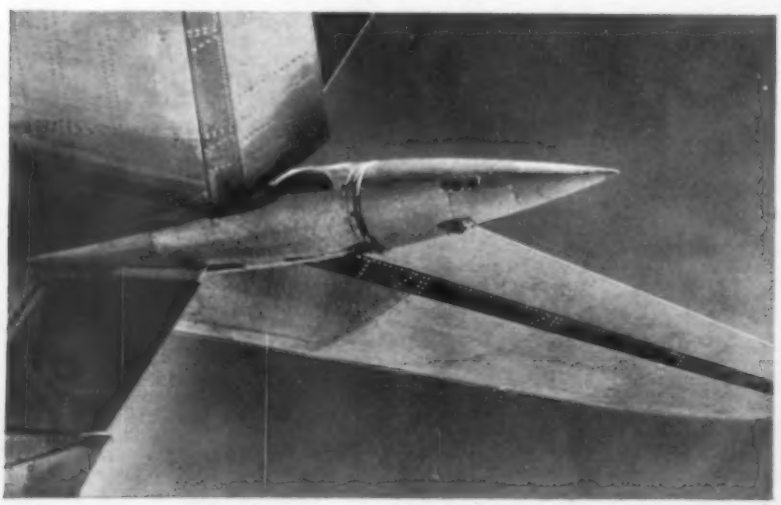
For the Record

SPEAKING at this year's dinner of the U.S. Air Force Association, held in Omaha, Nebraska, the Secretary of the U.S. Air Force, Mr. Harold Talbott, announced that a U.S.A.F. test aircraft had flown "considerably higher" than the 83,235ft mark set last year by a rocket-propelled Skyrocket of the U.S. Navy. No details of the height reached or of the aircraft concerned were given, except for the fact that the machine was air-launched. It was probably a Bell X-1A, X-1B or X-2. These great heights do not, under present F.A.I. rules, qualify for ratification as World Records, and the 63,668ft record of the Olympus-Canberra still stands. Mr. Talbott also stated that the jet-aircraft endurance record had recently been broken by an air-refuelled Boeing B-47, with a time of 35 hr and a distance of 17,000 miles nonstop; that every U.S.A.F. fighter was jet-propelled; and that the U.S.A.F., building up to a 137-wing strength, now had 115 wings fully activated.

Silver Stars at N. Luffenham

TALEPIPE, the lively magazine published by the R.C.A.F.'s No. 1 Fighter Wing at North Luffenham, reports that the station has acquired four Canadair-built T-33 Mk 3s (Silver Stars). These Nene-powered jet trainers are the first of their type to be operated by the R.C.A.F. in England. They will be used for checking out new squadron pilots in jet technique, instrument flying practice and communications.

TIGHT-ROLLED BROLLY: Like other high-speed prototypes, the Supermarine 525 twin-Avon naval fighter carries a braking parachute in a tail housing. The 525 will make its first entry into the Farnborough arena this year.



Flight-simulator Circuits

BEFORE members of the British Institution of Radio Engineers, on Wednesday, September 29th, Mr. A. E. Cutler, B.Sc., Ph.D., of Redifon, Ltd., is to lecture on "Computing Circuits in Flight Simulators." The paper will be given at 6.30 p.m. at the London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, London, W.C.1.

Lasham Gliding Achievements

A CLIMB to 16,000ft, the highest recorded in a British sailplane this year, was achieved from Lasham by David Kerridge, flying a Weihe, on Sunday last. Other flights included one to 10,000ft by Philip Wills in his Sky—and one to 13,000ft by his son Christopher in an Olympia. The previous week-end the Surrey Gliding Club group celebrated its 10,000th 1954 launch, with heights of over 10,000ft being attained by no fewer than seven pilots. Among these, Lt. Col. Deane-Drummond flew to 14,300ft and R. Watson (on his second cross-country flight) to 11,500ft. Also logged were a 95-mile flight to Lympne by C.F.I. Alan Piggott in a T.21B, and a nine-launch record of 7 hr 41 min soaring by one Olympia.

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This Horrible Horse, said the M.D. with a pained expression on his face, is one of the worst examples of the mock-modern school of art. Note the hole where the haybag should be. Note the Desoutter Power Tool hanging inside it. Words fail me. The sculptor (foolish fellow) has got things the wrong way round and inside out. In the best modern art, which flourishes at Desoutter Hendon, the *horse* goes inside the *Power Tool. And* a much more useful, decorative and (if I may say so) lovable horse than that!

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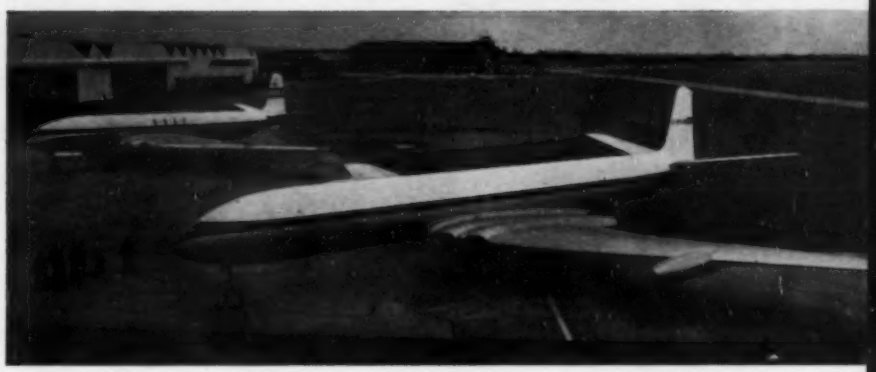
CIVIL AVIATION



PARTNERS: The prototype Comet 3 in company with a production Comet 2 at Hatfield. It is hoped that both types will be demonstrated at the S.B.A.C. Show.

THE COMETS 2 AND 3

A RECENT policy statement by the de Havilland Aircraft Company makes it clear that the Comet 2 and the Comet 3 airliners are regarded by the makers as essentially complementary in function—"the logical paired fleet for world travel for the decade ahead." The 44-seat Series 2 is shown as having an optimum stage length of 2,300 miles, and is offered as the logical replacement for piston-engined aircraft of comparable range. Thus, the argument runs, a typical long-haul operator might take delivery of Comet 2s late in 1955 for service early the following year. Some two to three years later, load factors, frequencies and aircraft utilizations would have built up to the point where an aircraft—the Comet 3—of greater range-payload capacity would be required to handle the traffic.

The Comet 3 is, of course, intended for service two to three years after the Series 2. With a payload of 17,000 lb, the larger machine is shown to be more economical to operate over all distances. With a 13,000 lb payload, however, the operating costs are 20 per cent higher than those of the Comet 2. On many present-day routes, it is thought, traffic offerings would in fact favour the initial use of the smaller unit at a high load factor. From the range viewpoint, the Comet 2 is considered capable of handling all but a relatively small number of "specialized" routes, an example of the latter being the North Atlantic; in this application, it is stated, the Comet 3 "can be operated at a competitive operating cost with a considerable advantage in time saved and a vast improvement in the comfort standard offered by conventional airliners."

The question "Turbojet or turboprop?" is one of the most fundamental problems facing air transport today; that there is no simple answer is illustrated by the contradictory, and sometimes equally convincing, philosophies emanating from manufacturers and operators. The de Havilland view is expressed by the manufacturers in the following terms: "The propeller aircraft of similar work capacity will always offer the slower journey and in order to satisfy a given traffic potential must, therefore, be of greater payload capacity and carry more passengers on each trip. It is, therefore, inevitably faced with two opposing factors. In order to achieve an economic load factor it must fill more seats per trip than the jet airliner. Against this, however, it cannot offer either the frequency or the standard of service which its jet competitor holds out. If seats are not filled or lower fares have to be charged in order to fill them, the revenue will suffer accordingly, and arguments surrounding fractional improvements in operating cost will not help to produce a profit at the end of the year's operation. The point . . . is that it is an interchange of utilization and load factor which produces the profit."

B.O.A.C. FLEET CHANGE

FROM September 1st, B.O.A.C.'s Stratocruisers and Constellations will no longer form a single fleet. Constellation 749s will be operated by a new fleet, with Capt. I. R. Stephens as acting manager. Capt. D. I. Peacock, the present fleet manager Stratocruiser and Constellations, will continue as manager of the Stratocruiser fleet (which will retain the Model 049 Constellations for the remainder of their service).

MORE L.1049s FOR K.L.M.

THREE more Super Constellations have been ordered by K.L.M., for delivery at the beginning of 1956. The company already has ten of these aircraft, and three more are due for delivery this year. The additional models will be L.1049Gs which—by comparison with K.L.M.'s present L.1049Cs and 'Es—will have a higher take-off weight (137,500 lb, instead of 133,000 lb), higher landing weight (113,000 lb, compared with 110,000 lb) and 200 miles more range with full payload.

HUNTING-CLAN EXPANSION

VISCOUNTS are likely to be introduced on the northern network of Hunting-Clan Air Transport, Ltd., some time next year. This news was given on Monday by the company's managing director, Mr. Maurice Curtis, who added that plans for using the new turboprop airliners—three are on order—would depend on progress at Woolsington Airport, Newcastle, the centre of the network, which serves Scandinavia, Holland, France and Germany.

Mr. Curtis also announced that all routes would be kept open during the winter, when Vikings would begin to take over from the DC-3s now operating the services. On the London-Newcastle route, Hunting-Clan would continue to offer two return flights daily, and schedules would be modified to allow the northbound visitor a full day in Newcastle.

To cover increases in costs since the network was inaugurated 18 months ago, fares would be very slightly increased. Next summer, it was hoped, the company would introduce a new service—from Newcastle to Bergen. Mr. Curtis said that traffic was increasing steadily on the new West African Safari service, and that Hunting-Clan and Airwork, joint operators, were considering an increase in frequency.

While Newcastle is the centre of the Hunting-Clan northern network, the company's base headquarters are at Bovingdon, which is also the terminal for the African and trooping services. Northolt is the terminal for London-Newcastle services. It is intended, however, to centralize all southern activities at London Airport, and on Monday Mr. Curtis disclosed that the move will begin on October 1st, when Hunting-Clan take over two bays of the former Comet hangar and offices at L.A.P.

The first step will be to make L.A.P. the terminal of the London-Newcastle service—on October 3rd—and other services will be transferred there progressively. Hangarage accommodation at London Airport, initially at least, will be insufficient for major checks, which will continue to be performed at Bovingdon.

"Flight" photograph

FERRYCOPTER: Delivery of this new Westland-Sikorsky S-51, seen leaving the South Bank for Ferryfield on August 17th, marks Silver City Airway's entry into the helicpoter field. The company has received M.T.C.A. approval to operate helicopter services (initially on an experimental basis) over all its existing vehicle-ferry routes to the Continent. The Fairey Rotodyne may eventually be adopted.

SERVICE AVIATION

Royal Air Force and Fleet Air Arm News

SIX SEATS IN THE CIRCLE: de Havilland Vampire T.11s in frisky form near the top of a formation loop. These Goblin-powered side-by-side-seat advanced trainers are now a familiar sight in the R.A.F., the Fleet Air Arm and thirteen overseas air forces.

No. 11 Squadron Standard

ONE of the original 30 squadrons to whom the late King George VI announced in 1943 the award of a Sovereign Standard, No. 11 Squadron are to receive their's tomorrow, August 28th, at R.A.F. Wunstorf, Germany. Air Marshal Sir Owen Jones, K.B.E., C.B., A.F.C., is due to make the presentation. Sir Owen, who is Controller of Engineering and Equipment, commanded No. 11 from 1936 to 1938, when the squadron was in India and was equipped with Hawker Hart biplane day bombers. He is taking with him to the ceremony F/Sgt. A. V. Hawes, now stationed at Wattisham, who was a L. A/C. fitter-airgunner with the unit when the Air Marshal was C.O. The present C.O. is S/L. E. Batche.ar.

Expected also to attend are Air Marshal Sir Harry Broadhurst, C-in-C. 2nd T.A.F., who served with the squadron from 1926 to 1931, and G/C. G. S. M. Insall who, in November 1917, won the squadron's first Victoria Cross.

In the first world war No. 11 served in France and Germany and in the second war saw service in the Middle East and Burma. The eight honours selected for the Standard are: Loos, Cambrai 1917; Somme 1918; Hindenburg Line; Egypt and Libya 1940-42; Arakan 1943-44; North Burma 1943-44; Burma 1944-45.

A.A.F.C.E. Visit

AS Commander-in-Chief of A.A.F.C.E., Air Chief Marshal Sir Basil Embry recently paid a visit of inspection to the Royal Canadian Air Force units of No. 1 R.C.A.F. Air Division in France and Germany.

At Bad Soellingen, where he was met by A.V-M. H. Campbell A.O.C. No. 1 Air Division, and General R. M. Lee, who commands 4th A.T.A.F., Sir Basil had demonstrated to him the comparative performances of the Mark 2 and Orenda-powered Mark 5 Sabres, with which the Canadian fighter units are now equipped.

Flying on to Grostenguin, in France, where No. 2 Fighter Wing is based, Sir Basil witnessed a ten-minute performance by the Air Division aerobatic team. He finally flew on by R.C.A.F. Dakota to Metz, where he met the officers of the Canadian H.Q. at an informal reception.

R.A.F. Appointment

SUCCEEDING A.V-M. W. M. Yool, C.B., C.B.E., A.V-M. W. J. Seward, C.B., C.B.E., has taken up the post of Director of Auxiliaries, Reserves and Air Cadets in the Department of the Air Member for Personnel.

A.V-M. Seward retired from the R.A.F. last May after a flying career which started with a commission in the Royal Flying Corps in 1917. Before that he served with the Territorial battalion of the Artists Rifles.

Sir Dermot Boyle's Flying

ALTHOUGH much pre-occupied with his duties as A.O.C-in-C. Fighter Command, Air Marshal Sir Dermot M. Boyle finds sufficient time to keep his hand in as a pilot. Recently he flew in a Meteor 8 to Malta G.C. to visit No. 611 (West Lancashire) Squadron, R.Aux.A.F., who were holding their summer camp in the island.

Three Canadian Awards

R.C.A.F. Headquarters have announced the award of the Queen's Commendation for Brave Conduct to three R.C.A.F. personnel. The awards go to W/C. R. W. McNair, D.S.O., D.F.C., F/L. G. C. Whitaker and F/Sgt. L. O. Jones.

All three awards are made for acts of courage and self-sacrifice. W/C. McNair receives the Commendation for his action immediately following the crash of an R.C.A.F. North Star transport in Vancouver last December. F/L. Whitaker's award is made for his action in dissembling a live canopy-ejection cartridge to determine the reason for its failure to explode. F/Sgt. Jones receives his award for his conduct in saving an airman from death or injury from an exploding grenade during ground defence training.

Rear-Admiral Braine

NOW serving as Command Supply Officer to the Flag Officer (Air) Home, Capt. (S) R. A. Braine has been promoted to the rank of Rear Admiral.

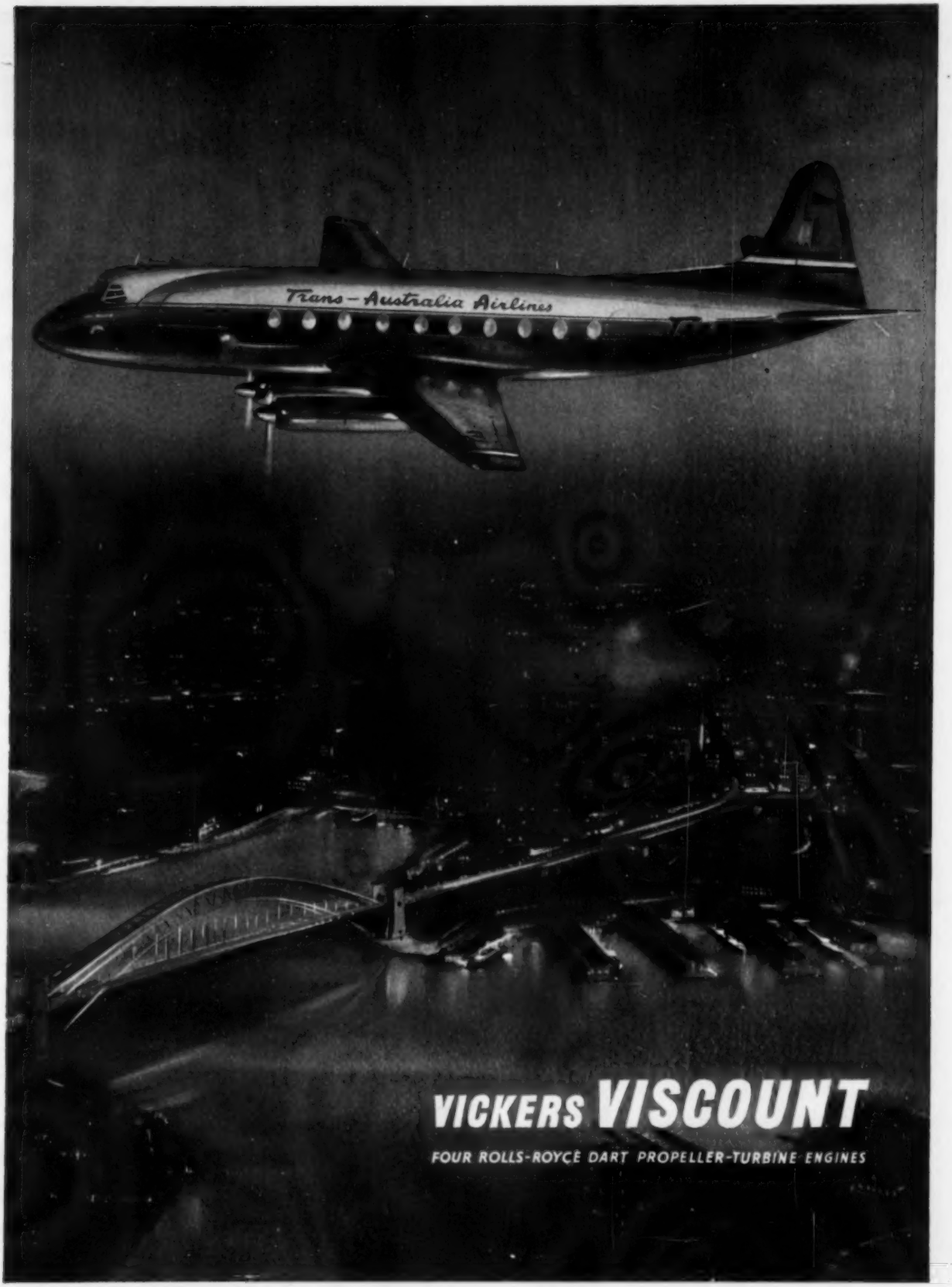
Life-boat Ceremony

ON the occasion of the 150th anniversary of the founding of a lifeboat station at Exmouth on September 1st, A.V-M. H. V. Satterley, C.B., C.B.E., D.F.C., is to name a new lifeboat *Maria Noble*.

Aird-Whyte Trophy

PRESENTED for weapons efficiency each year, the Aird-Whyte Challenge Trophy has been won this year by No. 206 Squadron. The unit is commanded by S/L. J. D. Beresford, who is at present with four of the squadron's Shackletons on a tour of the Far East.

H.M.S. "CENTAUR" in Grand Harbour, Malta. Ranged on the angled deck of this newly commissioned carrier are Sea Hawks: Sea Furies and Avengers. "Centaur" is 737ft long and carries a complement of 80 officers and 950 ratings in addition to the air squadron personnel, who normally number over 300.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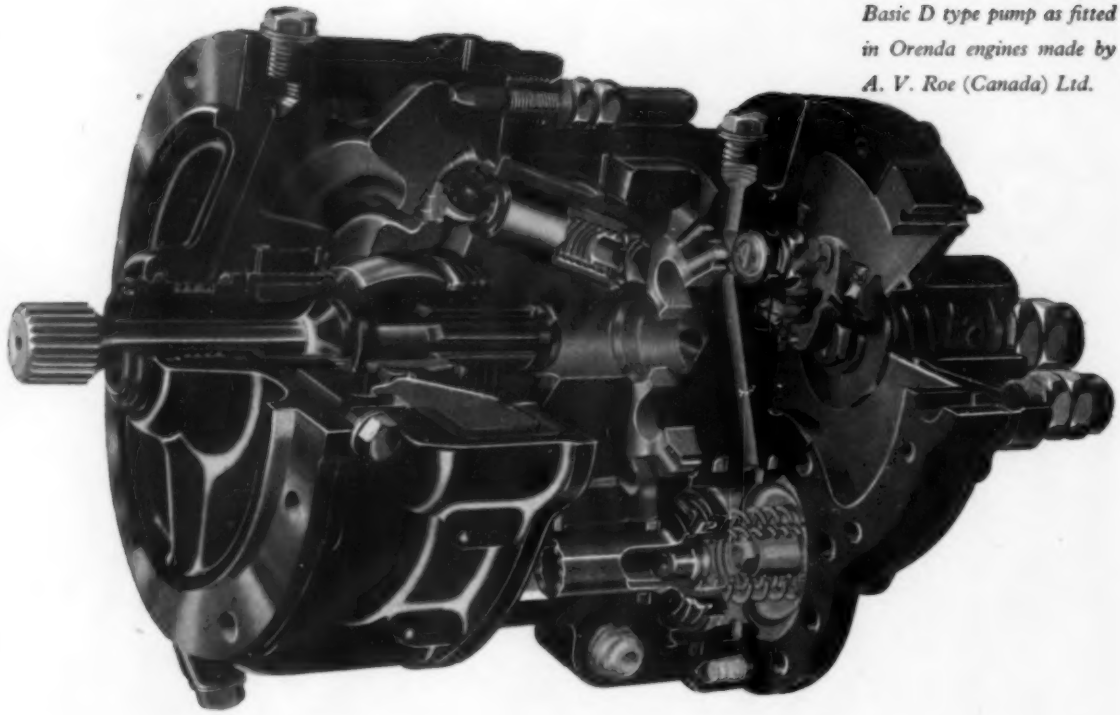

Basic D type pump as fitted in Orenda engines made by A. V. Roe (Canada) Ltd.

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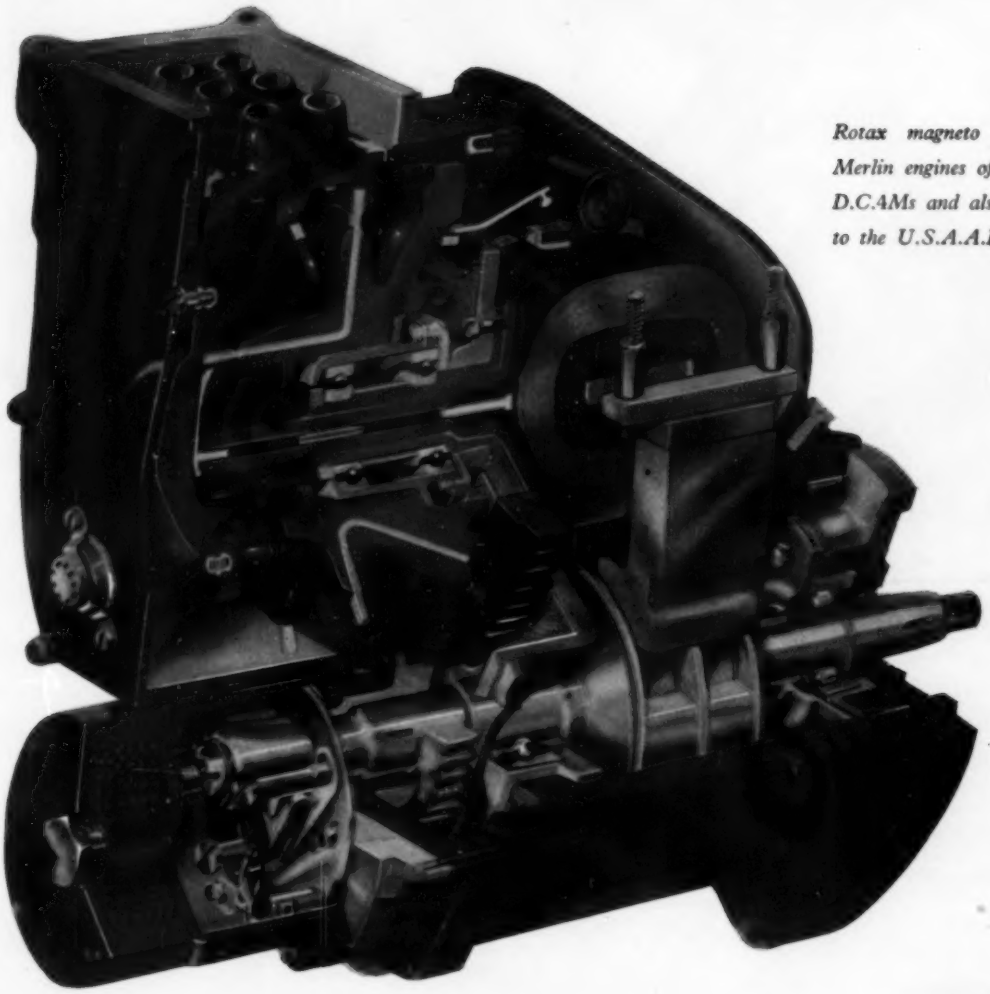

Rotax magneto fitted to Merlin engines of T.C.A.'s D.C.4Ms and also supplied to the U.S.A.A.F.

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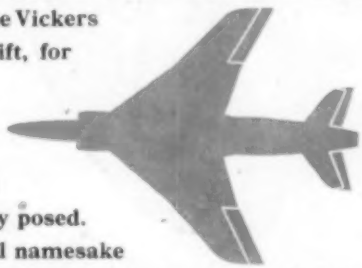
Problems of flight

WING SHAPES

Nature is a master of aerodynamics. She has devised, for the infinitely varied needs of her flying creatures, every wing that man could ever need.

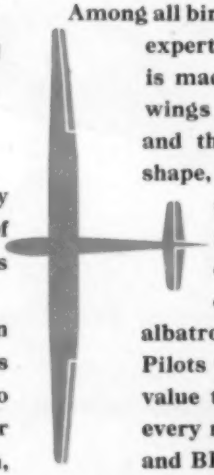
The wing of the Vickers Supermarine Swift, for example, solves problems that new engines and new enemies have only recently posed.



The Swift's small namesake needs speed as pre-eminently, for it lives largely on the tiny, almost invisibly fast-flying gnats of river-side and meadow. For this bird as for this aircraft swept-back wings are the answer.

The pheasant has very different needs. It lives in woodland, feeding and breeding on the ground. Its safety depends on its steep " rocketing " climb. So its wings are short for speed, broad and arched for maximum lift. Man's solution of the same problem, in carrier-based aircraft, is the same: the Hawker Sea Hawk needs the pheasant's short take-off and steep climb; so it has the pheasant's short broad wing shape. One other striking example among thousands is the albatross.

Among all birds the most expert glider, it is made so by its wings — narrow, and the longest of any bird. This wing shape, too, has been taken over by man to answer the special problems 'of soaring flight'. The wings of the sail plane exemplify exactly the same aerodynamic principles as those of the albatross, and to the same end.



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Copies of this advertisement can be obtained from Shell-Mex House.

Central African Airways Viking at Dar-es-Salaam

COMMONWEALTH AIR SERVICES

ANY airline timetable bears witness to the enormous strides taken since the development of British Commonwealth commercial air services began a quarter of a century ago. The most vivid example of their importance today, however, is surely found in the itinerary of the recent Royal Tour. Her Majesty the Queen and H.R.H. the Duke of Edinburgh travelled nearly 20,000 miles by air, mainly in civil aircraft of B.O.A.C. and the regular Commonwealth airlines. Their triumphant tour showed how real are the invisible bonds which unite the great family of Commonwealth nations; it also underlined the increasing extent to which members of that family depend upon their civil airlines for maintaining personal contact within and beyond the shores of their own countries. This review of the major Commonwealth airline operators therefore forms an appropriate introduction to the special Commonwealth issue of *Flight*.

AFRICA

Formed by the East African Government in 1946, the East African Airways Corporation operates an unduplicated route mileage of 22,000 miles with a fleet of nine DC-3s and three Rapides. The airline's primary rôle is the provision of a regional network covering Kenya, Uganda, Tanganyika and Zanzibar. There are also two services weekly from E.A.A.'s base at Nairobi to Durban. Last year the company carried 73,062 passengers compared with a total of 9,403 in the first year of operation.

The national carrier for the Federation of Rhodesia and Nyasaland, Central African Airways Corporation, was formed in June 1946 with a small fleet of Rapides and Ansons. Salisbury is the centre of the company's 8,000-mile network, which extends to London in the north and to Durban and Johannesburg in the south and is the base for C.A.A.'s fleet of nine Vikings, four DC-3s and six Beavers.

Over the past five years C.A.A.'s annual passenger traffic has increased from 24,000 to 126,000. In 1956 the company will take delivery of five Viscount 700Ds which will enable the present Salisbury-Johannesburg schedule to be reduced from 3¼ to 2½ hr and are also intended for service on routes to Dar-es-Salaam, Lourenço Marques, Durban and London.

An all-British fleet of ten Doves and five Bristol 170s is operated by West African Airways Corporation, which was formed by the governments of Nigeria, the Gold Coast, Sierre Leone and Gambia in 1946. W.A.A.'s services carry local traffic within these territories and also provide connections with international flights calling at Dakar, Accra, Kano and Khartoum. The present rate of passenger traffic is well over 60,000 annually.

Largest of the African airlines is, of course, South African Airways, formed in 1934 as a subsidiary of South African Railways and controlled by the Union Government. The S.A.A. fleet is made up of four Constellation 749s, seven DC-4s, three Dakotas and eleven Lodestar feederliners and the unduplicated route mileage is 15,374. Best known of the S.A.A. services is the Springbok Constellation service to London, operated in partnership with B.O.A.C., in addition to an extensive network of internal and regional services linking all the main cities of the Union and providing connections with Portuguese East Africa and Southern Rhodesia. S.A.A.'s annual passenger uplift is approaching a total of 200,000.

South African Airways Constellation, and (below) a DC-3 of E.A.A.

AUSTRALASIA

Australia's international flag carrier is Qantas Empire Airways, which originated in 1920 as Queensland and Northern Territory Aerial Service, Ltd. In 1934 Imperial Airways and the original Q.A.N.T.A.S. formed Qantas Empire Airways to operate part of the England-Australia route. Both the British and the private Australian interests were bought out by the Australian Government in March 1947. The company's outstanding operational performance over its 68,000-miles of long-distance routes is matched by an impressive commercial record: it has operated at a profit for 30 consecutive years. In partnership with B.O.A.C. Qantas operates the longest international route in the world—the Kangaroo route between London and Sydney. Two years ago Qantas inaugurated the 8,665-mile scheduled route between Sydney and Johannesburg *via* the Cocos Islands and Mauritius and on May 15th took over the former B.C.P.A. trans-Pacific service between Sydney and San Francisco and Vancouver. Other Qantas flights serve Japan, New Guinea and Pacific islands; altogether, Qantas links Australia with 24 other countries. The total of 81,839 passengers carried in 1953 appears relatively small but the corresponding total of passenger miles flown was more than 196 million.

Until recently the main-line Qantas routes were operated with a fleet of six Constellation 749As; these are now being replaced by L.1049C Super Constellations and four of the 749As are being transferred to B.O.A.C. Also in service with Qantas are five DC-4s, 13 DC-3s, four Sandringhams, four Catalinas, four Drovers and five Dragons.

By far the largest of Australia's flourishing independent domestic airlines is Australian National Airways, with a fleet of two DC-6s, eight DC-4s, 22 DC-3s and three Bristol Freighters. Two new DC-6Bs will join A.N.A.'s fleet in February or March. Since the formation of A.N.A., in June 1936, the company has built up an intensively operated route network of over 14,500 miles on which nearly 578,000 passengers and 37,000 tons of freight were carried last year.

A.N.A.'s major competitor was set up by the Australian Labour

Accra is the setting—and the name—of this W.A.A.C. Dove.

North Stars and Dakotas—one of each is pictured here at Dorval—have for several years carried practically all T.C.A.'s traffic. Super Constellations are now in service on the company's transatlantic route.

COMMONWEALTH AIR SERVICES . . .

Government in 1945 as the Australian National Airlines Commission. The Commission began operations, under the title Trans-Australia Airlines, in September 1946. The T.A.A. fleet of 41 aircraft (five Convair 240s, four DC-4s, 24 DC-3s, four Drovers and four Dragons) serves 97 points dispersed over a network of over 27,400 miles. Last year T.A.A. carried more than 663,000 passengers and nearly 17,000 tons of freight. A fleet of six Viscount 720s, the first of which has been completed, is due to enter service on T.A.A's routes later this year.

Between them A.N.A. and T.A.A. are responsible for about three-quarters of the scheduled passenger mileage flown within Australia. The Civil Aviation Agreement Bill of 1952 aims at providing for fair and active competition between the two airlines: it stipulates, for example, that they must receive equal allocations of airmail traffic.

Butler Air Transport carried nearly 140,000 passengers last year over a 3,000-mile system of local services based on Sydney. Largest of Australia's intra-state carriers, Butler was formed in 1934 and operates a small fleet of Herons and DC-3s. It recently announced an order for two Viscounts, with an option on a further four.

Local services in the Eastern states are operated by Ansett Airways, whose DC-3s carried 130,000 passengers last year. The company is reported to be planning the introduction of Convair 340s. South Australia's leading intra-state operator, Guinea Airways, also operating DC-3s, carried 83,000 passengers in 1953. In Queensland and New South Wales the Dakotas of Queensland Airlines carried 48,000 passengers. The five Doves of Airlines (W.A.) carried nearly 15,000 passengers last year on local routes throughout the centre of West Australia.

The airline known since 1927 as MacRobertson-Miller Aviation Co. originated as Commercial Aviation Service in 1919, and is thus the oldest of Australia's airlines. The company's network of local services extends from Perth to Darwin and is operated with four DC-3s and five Ansons; last year nearly 25,000 passengers were carried. Also prominent among local service operators is East-West Airlines which combined last year with South Coast Airways and which flies DC-3s and Ansons in New South Wales.

New Zealand and Australia are linked by Tasman Empire Airways, Ltd., which was formed jointly in 1940 by the Governments of New Zealand, Australia and the United Kingdom. Between April 30th, 1940, and June 27th, 1954, T.E.A.L. operated the Auckland-Sydney route entirely with Short flying-boats—successively, Empire boats, Sandringhams and Solents. The route has now been taken over by three DC-6s formerly used by B.C.P.A. At least one Solent will continue to operate T.E.A.L.'s "Coral Route" to the South Sea island groups of Fiji, Tonga, Samoa, Cook and Tahiti. The T.E.A.L. DC-6s also operate from Auckland to Nandi, Fiji (where they connect with the Qantas trans-Pacific service), between Melbourne and Christchurch, and between Sydney and Christchurch *via* Auckland. Well over 250,000 passengers have been carried without mishap by T.E.A.L. since its inception.

The first of T.A.A.'s six Viscount 720s was completed recently at Hurn.

Three Bristol 170s, as illustrated, operate all-cargo services for T.C.A.

One of the New Zealand National Airways Corporation's four Herons takes off from Wellington for a flight across the Cook Straits.

The domestic airline of New Zealand, formed by the Government in 1945, is New Zealand National Airways Corporation, which absorbed three private airlines with histories dating back to 1934. With the exception of the DC-3 service between Auckland and Norfolk Island, all N.Z.N.A.C.'s operations are within or between the north and south islands of New Zealand. The fleet consists of 22 DC-3s, four Herons (one of which carried H.M. The Queen during her visit), six Rapides and a Fox Moth. The number of passengers carried annually by N.Z.N.A.C. increased from 147,000 in 1948 to 350,000 last year, and since the airline's inception the original route mileage of 1,600 has also

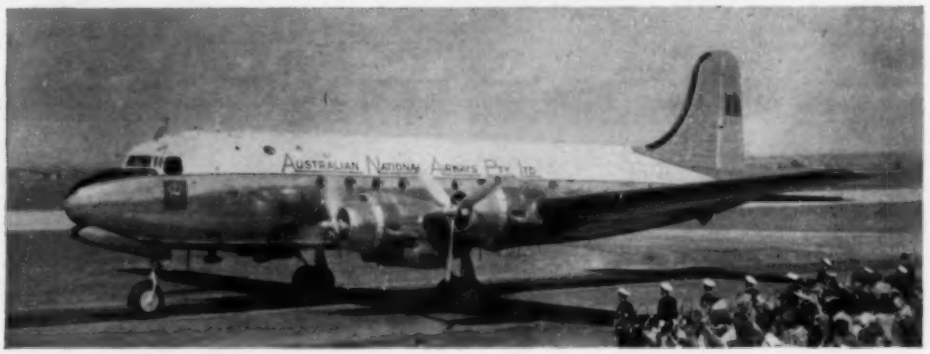
been doubled. New Zealand's airline is seeking a replacement for its DC-3s, and in this context stated recently that "a close watch is being maintained on the home [British] aircraft industry."

CANADA

The Dominion's largest airline operator, the State-owned Trans-Canada Air Lines, began operations in 1937. Its subsequent rapid growth reflects the tremendous industrial expansion within Canada during and after the war. The network has grown from a single 122-mile route (between Vancouver and Seattle) to a 20,000-mile system on which 1,607,000 passengers were carried last year. T.C.A.'s domestic services, over 11,000 miles of routes, span the entire continent; international routes covering a further 9,000 miles extend south to the United States, Bermuda and the West Indies, and eastward to the United Kingdom, Dusseldorf and Paris. The fleet consists of eight Super Constellations, lately introduced on the North Atlantic route, 22 Canadair North Stars, 27 Dakotas and three Bristol 170s used exclusively for all-freight services.

Using a fleet of fifteen Viscounts scheduled for introduction early next year, T.C.A. will be the first operator of turbine-powered aircraft on the North American continent. Specially equipped to operate under low-temperature conditions, T.C.A.'s Viscounts will fly on Canadian inter-city routes and will also carry the company's flag into the United States.

DC-6Bs operate C.P.A.'s trans-Pacific service between Vancouver and Sydney, and also fly to Tokyo and Lima, Peru.



During her visit to the Commonwealth, H.M. the Queen flew in this DC-4 of Australian National Airways, pictured here at Essendon Airport, Melbourne.

In 1942, the Canadian Pacific Railway took over ten bush airlines in the process of forming Canadian Pacific Airlines, which now has a route mileage of nearly 25,000 and is carrying passengers at the rate of well over 200,000 annually. C.P.A. operates with four DC-6Bs across the Pacific to Australia and the Orient, and the domestic fleet includes five Convair 340s, four DC-4s and 15 DC-3s. Recently, the company has also provided Vancouver with its first direct service to Lima, Peru; a weekly DC-4B service originating at Hongkong carries through to Lima *via* Tokyo, Vancouver, Mexico City and Rio de Janeiro. An order for four Comet 2s was announced last year.

Operating conditions in Canada are often far from ideal and many of the airlines employ a variety of bush aircraft in addition to the customary DC-3s. Queen Charlotte Airlines, for example, which was formed in 1946 to operate along the coast of British Columbia, has five Norsemen in addition to two DC-3s and two Cansos amphibians. A subsidiary, Air Carriers, handles charter work with a Beaver and Cessna 180. Central Northern Airways, which operates among mining districts in Ontario and Manitoba, has 11 Norsemen and three Ansons in addition to a Canso, Beaver and Lockheed 12. Perhaps the most diverse of the Canadian independent fleets is that of Pacific Western Airlines, which operates extensive contract services with 24 single- and twin-engined aircraft of 11 different types. The largest Canadian independent fleet is that of Maritime Central Airways, which operates scheduled passenger and freight services, mainly on Canada's eastern coastline, with nine DC-3s, three Cansos, three Electras and a Bristol Freighter. Five DC-3s, three Beavers and a Beechcraft make up the fleet of Quebecair, which took over Rimouski Airlines and Gulf Aviation. Points served by this company's scheduled services include Rimouski, Matane and Seven Islands.

With 51 passengers aboard, the first of the Qantas fleet of eight Super Constellations leaves Sydney to inaugurate the airline's trans-Pacific route to Vancouver. Qantas took over this route from B.C.P.A. on May 15th.

This handsome aircraft is the flagship of Air-India's fleet of five Super Constellations, which provide Bombay, Delhi, Calcutta and Madras with fast services to London and Tokyo.

COMMONWEALTH AIR SERVICES . . .

INDIA

All Indian independent airlines were absorbed into two state-owned Corporations when nationalization took effect in August last year. Domestic and regional services are operated by the seven "lines" of the Indian Airlines Corporation with a total fleet of some 80 aircraft; DC-3s predominate, but equipment also includes numbers of DC-4s, Vikings, Doves, and Beechcraft. It is reported that the Indian Government intends to order at least five Viscounts for this Corporation. Long-haul routes are flown by Air-India International, which originated as a private operator in 1932. The fleet of four Constellation 749As and a DC-4 has lately been supplemented by the first of five Super Constellations, now in service on the Air-India trunk routes to Tokyo and London. Two Comet 3s, due for delivery in 1957, are intended to provide express first-class service on these routes.

PAKISTAN

Newest of the Commonwealth operators is Pakistan International Airlines, whose inaugural service—the Karachi-Dacca link between West and East Pakistan—was flown on June 7th. This state-owned company has three new Super Constellations equipped to carry up to 74 passengers. At present there are four flights weekly on the Karachi-Dacca route and a weekly service to London will soon be added. It has been announced that P.I.A. will shortly take over the Pakistan domestic and Pakistan-India routes of Orient Airways. The Orient fleet consists of two Convairs (with two more on order) and 13 DC-3s.

OTHER COMMONWEALTH OPERATORS

Among the foremost Middle East airlines are Aden Airways, a B.O.A.C. subsidiary covering 20,000 miles of routes centred on Aden, and Cyprus Airways, both of whom have fleets of six DC-3s. B.O.A.C. and B.E.A. together have a 46 per cent interest in Cyprus Airways and the Cyprus Government holds a further 31 per cent; the remaining stock is held by private interests. Gibraltar Airways, in which B.E.A. hold a 51 per cent interest, operate a Rapide service between Gibraltar and Tangier.

One of the best known of British independent operators in the Far East is Cathay Pacific Airways, whose fleet of two DC-3s and a DC-4 are based at Hongkong; services extend to Manila, Singapore, Borneo and India. The Cathay Pacific DC-4 shot down off Hainan Island by Communist Chinese fighters on July 23rd was quickly replaced and the service resumed within three weeks.

Bush and feeder services are operated in many parts of the Commonwealth by D.H. (Canada) Beavers. This example, pictured at Kuala Lumpur, belongs to Federation Air Services, Malaya.

Connection between Hongkong and Tokyo *via* Taipei and Okinawa is provided by the regular DC-4 services of Hongkong Airways, also privately owned.

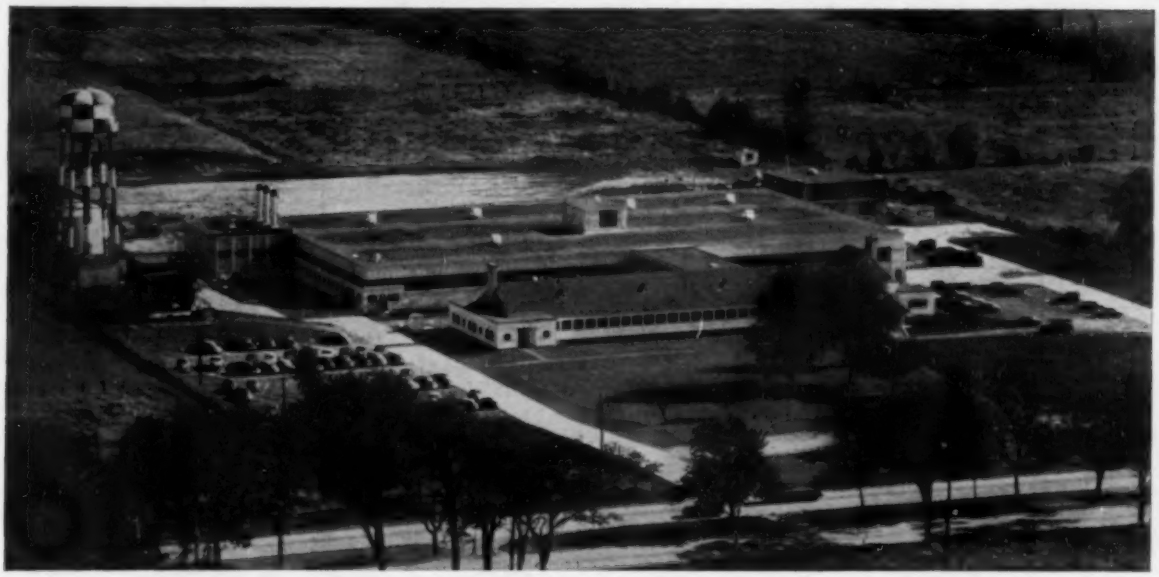
Malayan domestic services are flown by the eleven DC-3s and Rapides of Malayan Airways, in which B.O.A.C. hold a 10 per cent interest. Malayan Airways also operate to Siam, Indonesia, French Indo-China, Sarawak and North Borneo, and, on behalf of the Federation Government, provide local services to isolated parts of Malaya with Beavers, one of which is illustrated above.

Inter-island services in the Bahamas are flown by Grumman amphibians of the B.O.A.C.-owned Bahamas Airways. Largest of B.O.A.C.'s wholly-owned subsidiaries is British West Indian Airways, whose six Vikings and two DC-3s operate throughout the Caribbean and also provide connections with the mainlands of North and South America. Three Viscounts are on order for B.W.I.A. The British Corporation also has a 51 per cent interest in Gulf Aviation, whose four Doves fly from Bahrein.

British Guiana Airways are based at Georgetown, capital of the Colony and the centre of a network of local services and routes to Grenada, Trinidad, Barbados and Dominica. This independent fleet consists of three DC-3s and three Grumman amphibians.

The three Super Constellations of Pakistan International Airlines, now operating between East and West Pakistan, will shortly open an international route to London by way of the Middle East.

ROLLS-ROYCE OF CANADA



To reinforce Canada's vastly increasing aircraft industry, Rolls-Royce has established an aero-engine factory near Montreal, for the manufacture and overhaul of jet engines.

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A page from
THE ESSO HISTOIRE OF AERIAL LOCOMOTION
Adapted from the French de P. Crochet-Damais. Illustrated par Philippe Féty avec permission

KARL FRIEDRICH-MEERWEIN, BIRD-MAN

THE PRINCE OF BADEN'S architect, Meerwein, was a man of remarkable ingenuity and inventive skill, and most of his talent he applied to the problem of constructing kites—kites of all shapes and sizes and of every imaginable material. Fortunately for Meerwein the Prince was an indulgent master and took a great interest in the pranks of his protegé.

In 1781 the architect produced his masterpiece, an aerofoil capable of supporting a man, and there was intense excitement when the machine was first tested in the park of the castle. From J. J. Thourneysen ("*L'Art de voler à la manière des oiseaux*," Bâle, 1784) we learn that Meerwein soared gracefully for several moments and then crashed in front of the royal box. Consternation. Panic. Terrified footmen. A worried Prince.

But Meerwein picked himself unharmed from the wreckage and immediately returned to his drawing-board. He made many flights — most of them with equally dramatic results — and lived to win great renown throughout the duchy.

Today genius gets results by remembering that it pays to say

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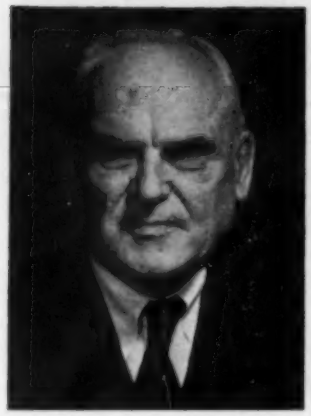
A Message from the Rt. Hon. C. D. Howe, P.C., B.Sc., Canadian Minister of Trade and Commerce and Minister of Defence Production

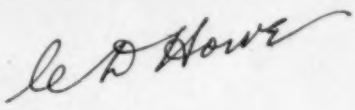


I AM pleased to have the opportunity to contribute to this issue of *Flight*, as many Canadian aircraft companies have parent firms in Great Britain, and these connections have contributed greatly to the present strength of the industry in Canada.

The Canadian aircraft industry has established an excellent record since Canada embarked on a defence preparedness programme at the time of the outbreak of hostilities in Korea. More than one thousand combat aircraft have been produced and a comparable number of high-powered turbine engines, in addition to utility and training planes. This effort has made available a considerable number of aircraft to the NATO forces, as well as completing the primary task of equipping the Canadian forces with up-to-date weapons.

The industry is entering a period where maintenance of the strength now built up will be the prime requirement. In order to accomplish this, programmes extending over time periods much longer than those previously envisaged become a necessity. As a result, the future of the aircraft industry seems relatively stable.

This expected period of stability is a product of the present state of tension in world affairs, and the industry is almost wholly dependent on Government orders. The true strength of the industry will be shown by the degree to which this dependency can be reduced, and I suggest this is the main task of the immediate future.



THE CANADIAN INDUSTRY

PRINCIPAL MANUFACTURERS

A. V. ROE CANADA, LTD.

LARGEST aircraft manufacturing organization in the Dominions, Avro Canada did not, like so many companies, start in a very small way; from the beginning their conception at least was on a comparatively grand scale to match Sir Roy Dobson's foresight of Canada's industrial opportunities and aviation developments. The staff and factory around which A. V. Roe was formed had, however, one thing in common with most others after the war—they had of necessity been allowed for the time being to run down to an almost non-productive nucleus. But today Avro are the only Commonwealth company to design and build both aircraft and gas-turbines.

It was on December 1st, 1945, that A. V. Roe Canada, Ltd., came into being as a new member-company of the Hawker Siddeley Group, on taking over from the Canadian Government the Victory Aircraft Factory at Toronto's Malton Airport, some eighteen miles north-west of the city. Victory Aircraft were themselves of particular interest because their most important wartime production had been the Lancaster bomber—no fewer than 430 of them were turned out in the two years beginning August 1943. (Four special Lancaster mail carriers and one special York were also built.) Had the war continued, Lincolns would have followed, and in fact the factory was tooled up for them and flew the first of five actually built between V.E. and V.J. days.

Continuing with these brief historical notes in reverse order, one finds that the Lancaster contract was given by the Canadian Government before it took over the plant. The company first concerned in 1941 was the National Steel Car Corporation, which was not "nationalized," despite the name, until a year later—and then under a new name. Another Avro design—the Anson—was also flowing from the Malton factory at about this time. The major units were sub-contracted to eleven other factories for manufacture, but assembly was done by National Steel Car Corporation and Victory Aircraft.

It was in this connection, incidentally, that the Editor made his first acquaintance of Malton when he collected a new Anson 2 from Victory Aircraft on March 10th, 1943, for delivery in Calgary, Alberta. Canadian Ansons (of more than one mark) differed considerably from the early home products, especially in having 330 h.p. Jacobs or, in the case of the Mk V and VI, 450 h.p. Wasp Junior engines, a modified rear fuselage and powered undercarriage retraction.

It may be said that the liaison at home and in Canada between the parent Avro company and the management of the Malton factory at this time unconsciously paved the way for A. V. Roe Canada, Ltd.

Before leaving the historical, it may be added for the record that the original portions of the present factory were constructed in 1938-9 and that National Steel Car built in their 50,000-odd sq ft of space, first Lysanders and then Hampdens and did conversion work on other types such as Harvard and Yale trainers.

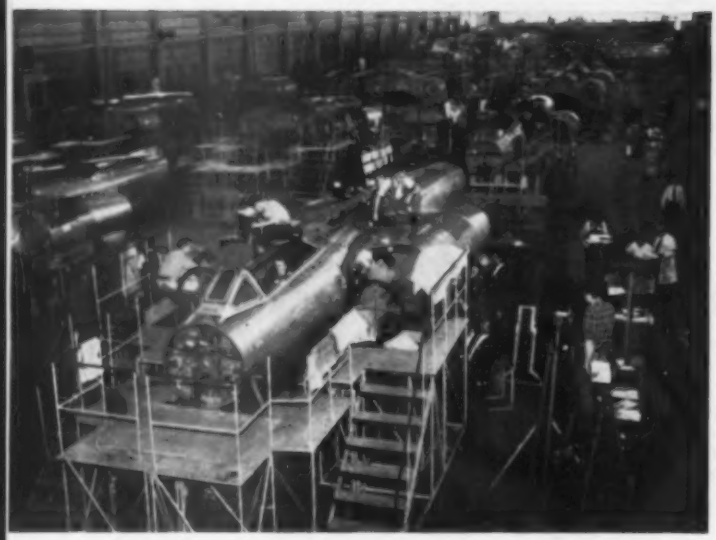
Aircraft came before engines for the newly-formed Avro Canada. As soon as it had found its feet and arrested the depressing immediate post-war effects, it set about studying Canada's future aircraft needs—national self-sufficiency being one of the main ultimate objectives.

Surprisingly and enterprisingly, the company decided from the start to tackle a very ambitious design—that of a medium-sized jet airliner. Official encouragement was given, and the staff of the parent company also lent a hand. As a result the C.102

Avro Canada executives (l. to r.) Crawford Gordon, Jr., president and general manager; Air Marshal W. A. Curtis, vice-chairman; Fred T. Smye, vice-president and general manager of the aircraft division.

THE CANADIAN INDUSTRY . . .

In the aerial view on the right is seen Avro Canada's aircraft division, foreground and left, and at the top right the gas-turbine division. (Below) Assembly of CF-100s at Malton.



Jetliner first flew on August 10th, 1949, only a week or two after the Comet I, and was the first and, until the advent recently of the Boeing 707, the only jet transport to be designed and produced in North America. The engines—the only ones available at the time—were four Rolls-Royce Derwents.

This project, after many hours' development flying, was shelved and effort concentrated on an important military design then in hand for an all-weather long-range fighter to meet the R.C.A.F.'s special needs. This aircraft, the two-seat CF-100, powered with two Rolls-Royce Avons, made its first flight on January 19th, 1950, a little more than three years after the design was started. On June 20th, 1951, it flew for the first time powered with Avro's own Orenda turbojets, produced by the engine division which came into being in 1946 and to which reference is made later.

A production order was given for the CF-100, and the first pre-production batch of ten was delivered by October 17th, 1951. The rate of output was rather more than one per week when the Mk 3 production got under way, and now the much-improved Mk 4 with Orenda 9 is being turned out. As may be read on page 280, this straight-winged aircraft is unusually well equipped, carries very advanced armament and has been dived supersonically.

The importance of the CF-100, in large-scale production, can be judged independently by the extent of sub-contract orders for various units and equipment which are discovered in the course of visits to other Canadian companies.

Since October 1951, the affairs of Avro Canada have been in the hands of Crawford Gordon, Jr., as president and general manager. He gave up various directorships, including that of the English Electric Co. of Canada, on assuming this new post. He had also been assistant to Mr. C. D. Howe, the Minister of Defence, in the capacity of production co-ordinator in the Department of Defence Production.

Sir Roy Dobson is, of course, the chairman, and Air Marshal W. A. Curtis is vice-chairman. The vice-president and general manager of the aircraft division is Fred T. Smye, and the general works manager is H. R. Smith. The chief engineer is J. C. Floyd and chief design engineer R. N. Lindley.

Today the combined aircraft and engine factories at Malton are most impressive by any standards. They total together 2½ million square feet of floor area, of which the aircraft division takes up 1½ million. The company is particularly proud of its pioneer use of three-dimensional models in its production planning. The very large number of patents for inventions from aircraft and engine divisions is also very significant. The total staff numbers about 14,000 of whom 9,000 work in the aircraft division.

Work has now started on the successor to the CF-100, a large all-weather fighter of delta wing-form known as the CF-105. Aerodynamically similar models will be used to provide early flight information.

Of the project "Y", the work of J. C. M. Frost, special projects chief design engineer, little firm information can be given. More than one variant has been considered. Our representative had various pieces of inside information whispered to him, but it seemed that nothing had crystallized except a mock-up behind large screens. It was better in the Spring to think in terms of "Howe and Y," Mr. C. D. Howe's support then being the key to its future. The impression was gained that there was considerable Mancunian support for the project and more than once it has looked like becoming quite a "big wheel" in Canadian air affairs; more recently it has shown signs of exerting some pressure with the aid of a lot of smaller ones. Abandoning the riddles, it may be added that American interests have been aroused by the revolutionary nature of the proposals underlying "Y", but to bring in U.S. dollars to back this Canadian/British brain-child might lead to political repercussions. A young, developing and materialistic industry is not on the other hand attuned to the expenditure of large sums of dollars for possibly no return. The shelving of the Jetliner was, of course, a great disappointment, and results are now expected for money—and credit—laid out in Canada.

It is to be hoped that a way will be found for the disc-like "Project Y" (could it stand for Yo-Yo?) to be built and flown; its vertical take-off possibilities, involving revolutionary air-bearing principles and its control with the aid of the Coanda effect, are, to say the least, intriguing and fashionable. And this is not the only project which Avro Canada have in mind.

Reference is made elsewhere to two important Canadian Hawker Siddeley Group subsidiaries—High Duty Alloys (Canada), Ltd., and Canadian Steel Improvements, Ltd.

Mark 4 CF-100s are now in large-scale production. Here a batch await their radar noses from America and their tip tanks before being flight tested.

Canadair executives are (left to right) J. G. Notman, president and general manager; W. K. Ebel, vice-president, sales; and R. A. Neale, vice president, manufacturing.

CANADAIR LTD.

INDIRECTLY, Canadair can claim to be one of the oldest, if not *the* oldest, aircraft manufacturing company in Canada. This, of course, does not take into consideration the concerns which produced flying machines during World War I and from which there has been no continuity of production.

The name of Canadair did not come into being until 1944, but the formation of the company also marked the conclusion of aircraft activities by Canadian Vickers, Ltd., whose business other than shipping was taken over by the newly formed Canadair. Canadian Vickers opened up back in 1923 and were soon building aircraft on a commercial scale, though not at the factory at Cartierville, Montreal. The company was noted for its work on winter landing-gear, and with the coming of the Hitler War it took on a great variety of aviation work, including the building of Consolidated-Vultee flying-boats under licence—these were the PBY or Catalina boats and the Canadian amphibian known as Canso. In addition, the company contracted for Stranraer flying-boats, Hampdens, Northrop overhaul work, Oxfords and some Anson and Bolingbroke sub-assemblies. The main factory taken over by Canadair was one of the wartime Government buildings and Canadian Vickers had managed it from its completion in 1942.

When Canadair was formed Canadian Vickers already held a contract to build a substantially modified version of the Douglas DC-4 for the Canadian Government. The rights in this connection were transferred to the new company, and in due course the DC-4M with four late-series Rolls-Royce Merlin engines came off the production lines. These aircraft are today the North Stars of T.C.A. and the R.C.A.F., and the Argonauts operated by B.O.A.C. In all, 74 DC-4Ms were constructed and delivered—on or ahead of time. The factory area in use was some 1,600,000 sq ft at that period.

So far, Canadair was purely a Crown management company, but in 1947 it was purchased by the Electric Boat Company of New York and it has since then been a wholly American owned concern. More recent changes have resulted in Canadair, Ltd., the Electric Boat Company (it would now be more appropriate, perhaps, to call it the Atomic Submarine Company) and Consolidated-Vultee Aircraft Corporation each becoming separate companies within the General Dynamics Corporation—all under the chairmanship of Mr. John Jay Hopkins.

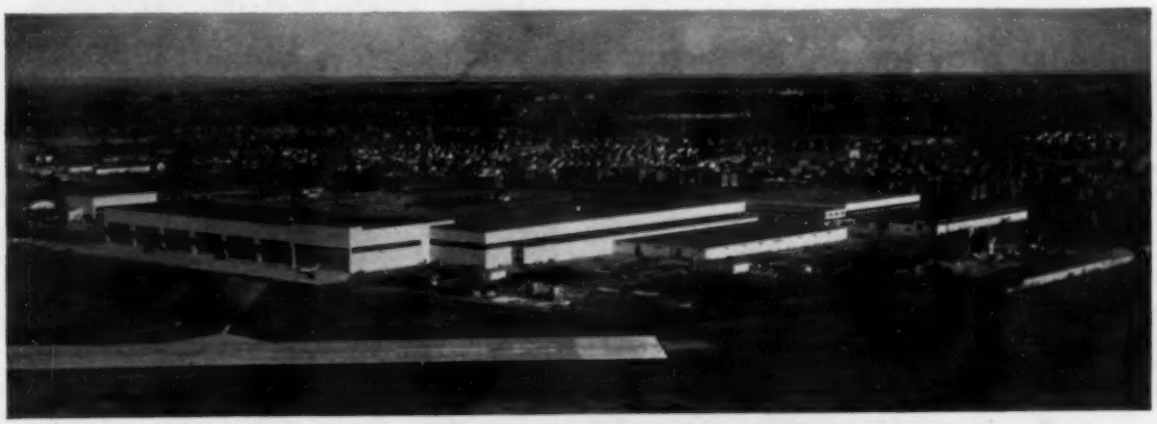
The company obtained in the summer of 1949 a most important contract to build North American F-86 Sabre fighters, the initial order being for 100. A year later the first example was finished. Then, in August 1951, a large order for T-33s (Lockheed Shooting Star two-seat trainers with Rolls-Royce Nene turbojet) was received, and these, together with the latest Sabres, still occupy the company fully.

The Canadair premises had grown considerably by the time Sabres were flowing. To the Government factory at Cartierville, known as Plant 1, had been added Plant 2, which was formerly part of the Noorduyn Aviation factory (Noorduyn had sold the manufacturing rights for the Norseman to Cancar and had itself become Nuclear Enterprises, Ltd., with no aircraft interests). Plant 3, now defunct, was a repair department at Dorval Airport, and Plant 4 was taken over from the aircraft section of Canadian Car and Foundry Co., Ltd.

Today Canadair occupy 2,250,000 sq ft of covered area—with plenty of space for expansion—all together at the three-runway Cartierville Airport outside Montreal. Plant 1, the largest, is devoted to machinery (presses, hammer and end-forming shops), the assembly line for the T-33 jet trainer, pre-assembly work for both T-33 and Sabre, and the pre-flight hangar. Plant 2 houses the Sabre assembly line and Plant 4 has become the repair, overhaul and maintenance section.

Both rates and numbers of production are remarkable, even though since the end of the Korean War there has been a slight intentional relaxation. As with Avro, so with Canadair; expansion had been extremely rapid, and, to avoid the risk of mushroom effects, a slight pause to consolidate and catch some breath was probably not unwelcome. Sabres, of which well over 1,000 have been built, have reached a peak production rate of two a day. The Orenda-powered Canadian Mk 5s (basically F-86E airframes), of which some 250 have now been built, differ considerably from the earlier all-American design in the portions around the engine and in having fixed, extended wing leading edges. The T-33 trainers also reached a two-a-day peak, and some 350 of an order understood to be for 576 have been turned out. The Sabres equip twelve Canadian NATO squadrons and the T-33s are used by the R.C.A.F.

Some two years ago a substantial contract was placed with



(Above) Canadair's No. 1 plant at Cartierville. (Left) The pre-flight hangar showing T-33 Nene-powered trainers and Orenda-Sabres.

THE CANADIAN INDUSTRY . . .

Canadair's Sabre assembly lines in the company's No. 2 plant at Montreal.

Canadair to produce Beech T-36 aircrew trainers for the U.S.A.F. The cancellation of the order at a late stage was a considerable blow to the company and its sub-contractors.

Employment in Canadair now totals about 10,000 as compared with 12,000 a year or two ago. The figure is now on the increase again. As a result of scientific production-planning the 1,000th Sabre required only 86 per cent of the man-hours that were needed for the first production machine.

The outstanding impression gained during a tour of the whole factory is one of concentrated activity. There are also plenty of indications that the men concerned are aware of the overall aim and purpose of the company rather than confining their interests to their own particular job.

About two years ago, Canadair prepared a design for a light-to-medium transport aircraft in the DC-3 direct replacement class, but last year as a result of the disappointing response judged from a comprehensive market survey, the CL-21 project was shelved.

In the meantime, however, an even more important contract was in the offing for a maritime reconnaissance version of the Bristol Britannia. An order has now been authorized by the Canadian Government, for whom Canadair act in the capacity of agent/manufacturer. The licence agreement with Bristols does not include civil Britannias. Canadair will employ the efficient and excellent Britannia airframe, fit it with Wright compounded piston engines (for range, slow speed and low-level operations over water) and re-equip it to North American military standards.

Canadair's previous experience in developing and working with new sub-contracting companies which are now being brought in to form a quite large supporting industry, will no doubt be most valuable in connection with this new major contract. It is said that 50 M.R. Britannias will eventually be involved, that first deliveries are desired late next year and that the initial order is for 13. Both engineering facilities and staff are being enlarged in readiness.

Obviously Sabre production will not continue for very much longer, and a successor is being sought. The North American F-100 Super Sabre is considered a likely machine to follow on.

Early in July Canadair announced that "in order to give greater scope to the engineering facilities of the company" a new building was being constructed to house test equipment. Some 100ft wide and 120ft long, it will be of two storeys for a start, but with provision for a third to be added later. Included in the equipment will be an altitude simulator capable of duplicating pressure, temperature and humidity likely to be encountered by aircraft component systems up to 80,000ft. The work and equipment of this new section will be in the hands of Mr. Dick Richmond, chief development engineer.

Reference has already been made to John Jay Hopkins, chairman and managing director of Canadair. The president and general manager is J. G. Notman; vice-chairmen F. Pace, Jr. (also executive vice-president of General Dynamics Corp.), and L. B. Richardson. Vice-presidents in charge of manufacturing, engineering and sales are R. A. Neale, W. K. Ebel and P. H. Redpath.

CANADIAN CAR AND FOUNDRY CO., LTD.

BETTER known, perhaps, in heavier industry as the principal Dominion producers of railway equipment and commercial vehicles, Cancar's continuous connection with aviation dates from 1937, rises to a peak in the war years when several factories were engaged on aircraft manufacture, and then after a short hiatus settles down to a steady trainer production in recent years.

In 1937 an aircraft division was establised at Fort William, and work was done on a contemporary Grumman fighter. The beginning of war, two years later, found Cancar with a modest aviation organization, and a staff of about 600 engaged on aircraft sub-contract work. An immediate concentration on war production resulted in the next five years in quite extraordinary development and results, some 1,650 Hawker Hurricanes being turned out for the R.A.F. and 836 Curtiss Helldivers for the U.S. Navy.

After a period of recession in the late 1940s, Cancar again got moving on a considerable scale, and by early this year had de-

Cancar's president and managing director (left) is E. J. Cosford; the aviation division sales manager is L. H. Kottmeier.

Assembly of Harvards at the Fort William plant.

livered 555 Harvards. At first, according to the agreement with North American Aviation, these machines could only be built for a limited market, but recently the licence was altered and a new agreement made by which Cancar gained exclusive rights to manufacture the Harvard and its spares and to sell on a world-wide basis (except for the U.S.A.).

Towards the end of the Harvard job, work started on sub-contract orders in connection with Canadair's order for Beech T-36 aircrew trainers for the U.S. Air Force. Plans were much upset when this whole American order was unexpectedly cancelled at the eleventh hour.

In its place Cancar followed up this disappointment with another American order for 100 T-34A basic trainers also for the U.S.A.F. and with 25 for the R.C.A.F.—all with the requisite spares. These are occupying the company's Fort William plant

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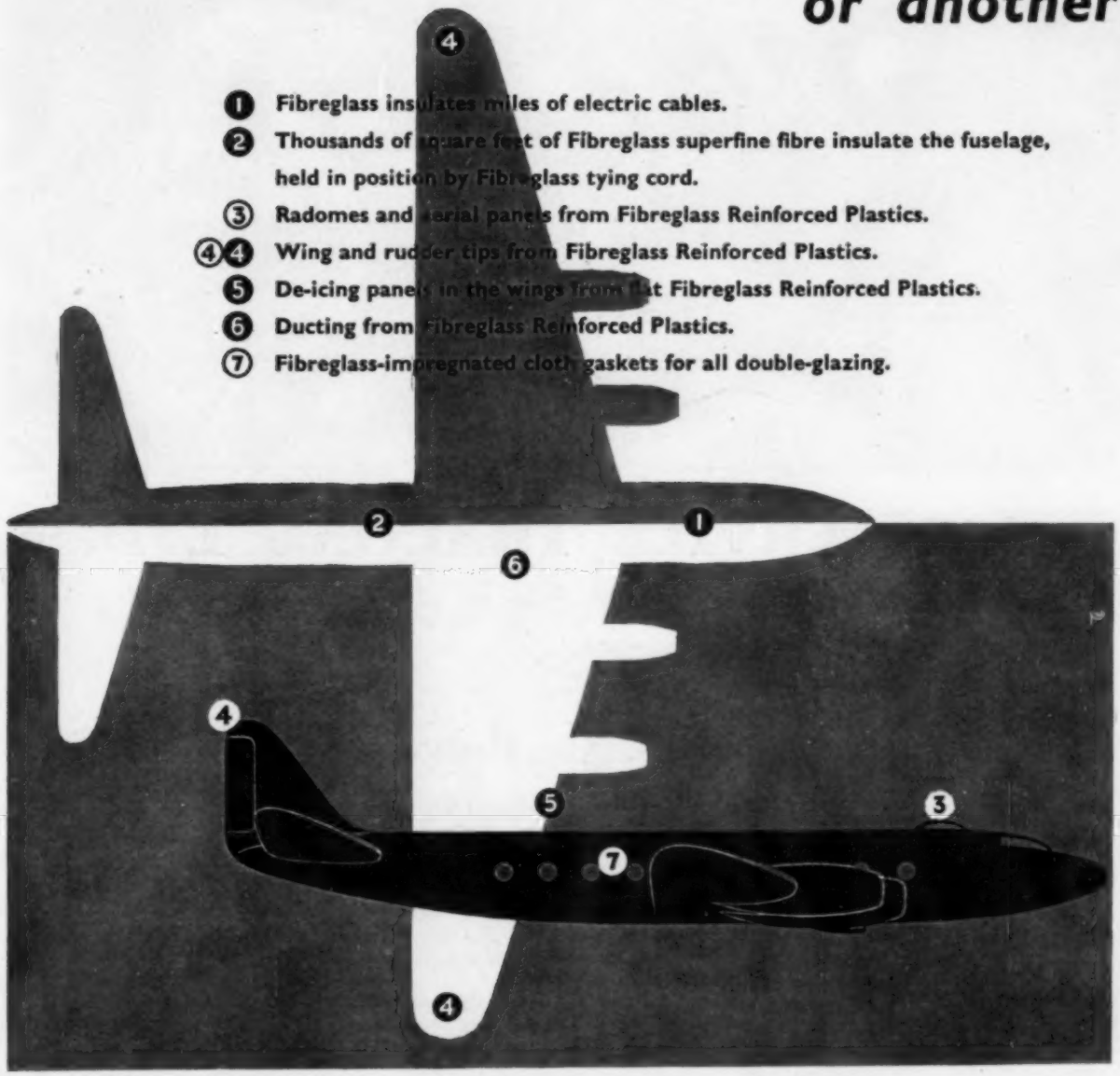
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THE CANADIAN INDUSTRY . . .

now. One or two special items are sub-contracted, but otherwise the T-34s are being produced entirely by Cancar.

In addition to this work, Cancar are to take a large share in the construction of anti-submarine Grumman S2Fs for the R.C.N. Most of the manufacturing work is being sub-contracted and de Havilland, who are handling the programme, will look after assembly. Cancar's share is the complete wing with control surfaces, flaps and engine nacelles.

The president and managing director of Cancar is Edwin J. Cosford. The aviation division sales manager L. H. Kottmeier, who has been a pilot for some 25 years, has worked on aircraft design and manufacture in America, and during the war served in the R.C.A.F.

The company's aircraft division now comprises a main assembly shop of 216,000 sq ft area, a machine shop of 17,600 sq ft, other buildings totalling 112,000 sq ft and two hangars at the Montreal Municipal Airport giving 47,000 sq ft. The present aviation staff totals a little over 1,500.

THE DE HAVILLAND AIRCRAFT OF CANADA, LTD.

LIKE its Australian sister company, de Havilland Canada has now been established for more than twenty-five years; Jubilee celebrations were, in fact, held last year. The actual date of formation of the company was January, 1928. Five men with some crated equipment put up their sign in that year at De Lesseps Field, Mount Dennis. Field meant field. For a start Cirrus Moths were assembled, and they proved so popular that about a year later, in September 1929, larger premises, allowing for growth were opened at Downsview to the north of Toronto. By this time a staff of 80 was employed.

Several names are specially associated with the origin and the development of D.H. Canada before the war. Captain Roy Maxwell, as a director of the Ontario Provincial Air Service, visited England in 1927 and at Stag Lane saw a demonstration with the Cirrus Moth. It seems that he was much impressed with the aircraft's possibilities, particularly for fire detection in Ontario, and it was upon his recommendation on return home that the then Minister of Lands and Forests in Ontario ordered four Cirrus Moths for the Provincial Government's forest fire detection service.

At the time of this first purchase F. E. N. St. Barbe was sales director of the home company, and it was he more than anyone else at de Havillands who recognized the opportunities for introducing air transportation in Canada to overcome the almost insurmountable problems associated with over-land transport. Others to be named are Mr. R. A. (Bob) Loader who, in January 1928, was given the work of forming the new company; Frank Tretheway (a member of the Toronto Flying Club), whose farm provided the first site for operations; P. C. Garratt, now vice-president and managing director, who among many other things badgered the Canadian Government into giving the first Tiger Moth order in 1937 (for 25 aircraft), thus giving the company its first chance to become a manufacturing concern rather than one for assembly, repair and maintenance. In the past Mr. Garratt often voluntarily added the work of test pilot and ferry pilot to his other responsibilities.

Although during its earlier years the company did not design or build whole aircraft, a great deal of work was done to provide for the special needs of Canadian terrain and climate and, for example, float and ski systems were developed and a lot of experience gained in the handling and carriage of heavy and bulky freight in comparatively light bush aircraft.

Only a short time after the small but important order for Tiger Moths had been placed by the Canadian Defence authorities, the British Government gave an order for 200 Tigers and the Canadian version of this aircraft, the D.H.82C, became the standard elementary trainer for the British Commonwealth Training Plan in Canada. This machine differed in several important respects from the English Tiger, having a sliding coupé cockpit enclosure, cockpit heater, wheel brakes and tail wheel, and provision for the fitting of floats or skis.

Wartime expansion of the company was nothing short of spectacular. Tiger Moth production continued non-stop until 1,747 of these aircraft had been built. In 1940 a contract was placed for the assembly of Ansons at Toronto, and 375 of these were completed. A year later the company started to tool up for Mosquito production. The first Canadian-built Mosquito was ready for testing in September 1942, and before production was brought to a close more than 1,000 Mosquitos were built. At its wartime peak the company's payroll reached 7,200.

As for almost every other wartime producer, the latter 1940s brought a trying period of contraction and consolidation. The company could only retain a small proportion of its huge wartime staff and productive capacity. Surprisingly (and courageously), the first post-war machine to be chosen for production without delay was a modified version of the old Fox Moth, and that this was a sensible choice is confirmed by the sale of more than fifty of these machines in spite of the availability of so many war surplus aircraft at the time. The Fox Moth is, in effect, a versatile light

(l. to r.) Vice-president and managing director of D.H.C. is P. C. Garratt; engineering director, W. D. Hunter; and sales director, C. H. Dickins.

(Below) D.H. Canada's fine new premises at Downsview, outside Toronto. Otters and Beavers can be recognized. (Right) The Beaver (L-20s for the U.S.A.F.) production line.

THE CANADIAN INDUSTRY . . .

bush transport, and its choice for production was largely influenced by the availability of many wartime components which it had in common with Tiger Moths.

May 1946 was an extremely important month for D.H.C., for it was then that the prototype of the attractive and successful Chipmunk, successor to the Tiger Moth, made its first flight. Though not yet so widely used as the Tiger itself, Chipmunks are now to be found in many parts of the world and in many Air Forces. Large numbers have, of course, been built by agreement in England. Canadian Chipmunk production was stopped in December 1951 after 158 had been built.

The drawing office in the engineering section of D.H.C.'s new factory.

Almost concurrently with the design, development and production of the Chipmunk, similar work was proceeding on the even more important Beaver. The decision to proceed with its design was made early in 1947 and the prototype took to the air in August 1947. Later in that same year—and one recalls the Cirrus Moth order of twenty years earlier—the Ontario Provincial Government placed an initial order for four Beavers (the Department of Lands and Forests has now taken delivery of forty).

In addition to the outstanding service which the Beaver has given in its initial role of bush aircraft in the widest sense, the design also achieved another outstanding success when in competition with six other aircraft it was selected by the United States Air Force as a standard liaison aircraft. As a result a large contract for L-20 Beavers for the U.S.A.F. was placed with D.H. Canada. Details of the Beaver 1 with Pratt and Whitney engines appear on page 283. (The Beaver 2 is Alvis powered.)

Beaver production continues in full swing at Downsview Airport and one of the latest variants of the basic design has been specially adapted for agricultural uses—fertilizing, seeding and spraying.

Side-by-side with Beaver production is developing the Otter line, and an important order towards which deliveries have already been made has been placed by the Royal Canadian Air Force. Like the Beaver, the Otter is also operating off floats and skis. With the exception of range, which at 1,145 miles for the Otter is nearly twice as much as that of the Beaver, the performance figures for the two aircraft are very similar. The all-up weights are 7,600 lb (3,242 lb disposable) and 5,100 lb (2,140 lb disposable) respectively. The Otter's geared Pratt and Whitney R-1340 radial gives 600 b.h.p. as compared with the 450 b.h.p. of the R-985 Wasp Junior in the Beaver.

Today, after 26 years, the direction of D.H. Canada is (in this country) still under the president, Sir Geoffrey de Havilland, F. E. N. St. Barbe and W. E. Nixon, and in Canada under the vice-president and managing director Philip C. Garratt. The other directors in Canada are C. H. "Punch" Dickins, a famous bush pilot and formerly vice-president of Canadian Pacific Airlines (sales); G. J. Mickleborough (secretary-treasurer), in 1928 the second Canadian to join the company (back in 1930 he accompanied the then sales manager Geoff O'Brian on his Toronto-Vancouver return flight in a Puss Moth—6,050 miles in 57 hours); W. D. Hunter, who went to Canada in 1941 to organize the production of Mosquitos (engineering); W/C. R. Bannock, first post-war chief test pilot and military sales manager (operations); D. G. Simpson (financial); and W. W. Parry, Q.C.

Today in the fine new factory here illustrated, 2,200 people are working to produce the Beavers and Otters, to service other D.H. types, including Vampire and Comet, and preparing for the assembly of American Grumman S2Fs (two Wright R-1820 engines) ordered for the Canadian Navy for anti-submarine duties.

FLEET MANUFACTURING, LTD.

MANY if not the majority of names in the Canadian aircraft industry in pre-war days were those of parent companies in England and America: de Havilland, Canadian Vickers, Fairchild are examples. Fleet Aircraft of Canada, Ltd., was one of this early band but rather than take the name of the American parent company, it took that of its president. Major R. H. Fleet was president of Consolidated Aircraft Corp. in 1929 when the company was formed. (Fleet Aircraft, Inc., was also registered in America.)

The aircraft first built was a well-proportioned biplane trainer with 125 h.p. Kinner radial. The R.C.A.F. bought twenty. It was tested for floats, skis or wheels, and a neat coupé top could be fitted—a refinement ahead of its time.

A pleasant factory was built in 1930 at Fort Erie for the company's products, and it grew steadily and impressively for the times until war came. Large numbers of the current Fleet primary trainer—the Finch—were at once put in hand and some 600 built by 1941. Concurrently 100 Fleet Forts for more advanced training were turned out.

Fleet achieved the distinction during the war of producing more aircraft in terms of manhours per lb of airframe weight than any other manufacturer. The work following at once on the early trainer programmes mentioned in the previous paragraph included 3,000 Cornells (Fairchild PT-26A), trainers of Chipmunk size and layout, and also major components for the Hampden and later the Lancaster.

The company describe the middle 1940s and the years to date as follows: "Fleet's fortunes, which reached a peak during the War years, came very near to foundering on the rocky shoals of post-war recession but, following its complete reorganization early in 1953, the company is once again on a sound operational and financial footing, as reflected in its annual statement for the year ending September 30, 1953, when a net profit of over $400,000.00 was reported."

H. L. Eberts, president and general manager of Fleet Manufacturing, Ltd.

The most important aircraft work undertaken by Fleet recently has been under sub-contract to Canadair. Rear fuselages, wing centre sections, spars, leading and trailing edges and some additional small sub-assemblies for Sabres were involved. When this contract was signed certain key men from Canadair went over to strengthen the Fleet top-level staff.

Other Canadian sub-contract work includes flaps and ailerons for Avro's CF-100s and large numbers of fuselages, wings, sub-assemblies and spares for D.H. Canada Beavers.

For America, Fleet has made Thunderjet and Thunderstreak undercarriage units on behalf of Republic Aviation Corporation.

Aircraft skills and technique have also been applied to an important sub-contract for the building of large radar scanners.

Reference must be made to the plastic department in which a variety of canopy and other moulding work is handled and non-aviation Fiberglas products are manufactured.

Today the Fleet payroll is approaching 1,000. The factory, beside which is a private airfield with an 800 yd paved runway, occupies a 162-acre plot on the American-Canadian border at Fort Erie.

Fleet's factory at Fort Erie, Ontario. The end of the runway is seen in the background.

The buildings extend to 300,000 sq ft and have been regularly re-equipped to keep machine tools and other production plant up to date.

The president and general manager is H. L. Eberts and the manufacturing manager R. B. Daniels (both late of Canadair). The chief engineer is H. Louis and, ex-Avro, the contracts administrator is V. Symonds.

The latest developments at Fleet may well bring the company back into the front line of Canadian aircraft manufacturers. An agreement has been signed for Commonwealth manufacturing and sales rights for the Helio Courier—an American high-wing all-metal executive and light transport design with exceptional speed range and small-field performance. In addition Fleet have acquired similar rights in connection with the six-seat Doman LZ-5 helipcoter. Constructional work has started on these aircraft and a complete rear fuselage and tail section of the Courier, Fleet-manufactured, was one of the company's several aircraft exhibits at the Canadian International Trade Fair this summer.

Manufacture under sub-contract of F-86 leading-edges at Fleet's factory.

A. V. ROE CANADA, LTD., ENGINE DIVISION

IN 1946, the year following the formation of the aviation division of Avro Canada, the company took over from the Government the responsibility for national research and development of gas turbines. This involved the absorption of Turbo Research, Ltd., a Government organization set up in August 1944, into the Avro company. Prior to this, Canada's interest in the new prime mover had been limited to wartime liaison and technical missions. Mention must, however, be made of the Canadian National Research Council's cold-weather research station at Stevenson Field, Winnipeg, which was set up in 1943 and later became a part of the Turbo Research organization.

Avro's first action was to further the progress of Canada's first turbojet design, a development engine known as the Chinook, upon which work had started under Turbo Research. (This was a nine-stage axial-compressor design with single turbine. It developed about 2,600 lb thrust and weighed 1,250 lb.) As a result it was ready for its first run in March of 1946. In addition, their aircraft division having just begun work on the design of the CF-100, Avro's soon started to design an engine for them. This was the beginning of the Orenda story. Remarkably enough, with little gas-turbine design experience except that brought by the men recruited to the staff of the then newly formed division, the team aimed high and succeeded in producing a modern axial-flow unit of over 5,000 lb thrust which ran early in 1949. It suffered comparatively few early troubles, and had passed type tests to Canadian and British standards within nine months. Today the standard rating stands at over 7,000 lb and more than 1,500 units have been produced for the CF-100 and Mk 5 Sabre built by Canadair.

To meet the scale and rate of production needed for the Orenda, it was decided in mid-1950 that a new factory must be built. Work started as weather permitted next spring, and the factory was in full swing a year later—May 1952. An official opening ceremony was performed by Mr. C. D. Howe on September 29th of that year. This factory was paid for by Government money, but it is operated entirely by Avro. The vice-president and general manager is W. R. McLachlan; the director of engineering Val Cronstedt; the general works manager E. K. Brownridge; and the chief engineer C. A. Grinyer.

Today the plant is something of a showplace, having the advantage of being designed for its purpose from the start and, having been recently equipped, of containing much fine new machinery.

An imposing line-up of Avro Canada Orendas awaiting shipment.

The Avro engine division is now conveniently sub-divided into the logical three sections: design, development and production. To these should perhaps be added an extra section—the sub-contractors—for as with the CF-100 airframe, a large proportion of the components of the Orenda are bought out.

Early in the life of the Chinook design, development in connection with the compressor, combustion system and turbine was carried out at laboratories at Nobel, Ontario, 130 miles north of Toronto, and this establishment continues to function and did similar work in connection with the Orenda.

Quite recently a new company has been formed within the Hawker Siddeley Group. It is known as the Canadian Steel Improvement Co. (see page 298), and one of its objects being the production of titanium, it is likely to have an important influence on Avro Canada products in the future.

A successor to the Orenda is now on the way, and unofficially the name Waconda has been mentioned for it. Except that it is a very high-powered turbojet, nothing may be said.

CANADIAN PRATT AND WHITNEY AIRCRAFT CO., LTD.

ONE of the earliest engine companies to become established in Canada, the Canadian Pratt and Whitney Aircraft Co., Ltd., was incorporated on November 29th, 1928, for sales, service, spares and representation on behalf of the parent company. It has continued this work ever since, taking on each new Wasp engine as it was produced by P. and W. in America. The company is 70 per cent United Aircraft Corp. owned, the remaining 30 per cent of the shares being in the hands of the Canadian directors.

Two most important dates for the company in recent years were June 7th, 1951, and September 19th, 1952. The former was the day upon which work started on the fine new factory at Jacques Cartier, Montreal, and the latter the time, only fifteen months later, when with factory completed and equipped work was publicly declared to be under way. On the 19th the president of C.P. and W.A., Ronald T. Riley, forecast that within three months 600 h.p. Wasp R-1340 engines would be in production. The extent of the Canadian Defence Department's order was not revealed but a 300-a-month production capacity was claimed. The new production factory is within a mile of the earlier one at Longueuil where overhaul and supply work continues.

Wasps are now being turned out at the rate of two a day and their spares and, in Canada, have been fitted to such aircraft as Cancar Harvards and D.H.C. Otters. The Canadian factory is now, however, the only one building these units.

In emergency, production could be greatly stepped up in the new factory and the plans exist for a four-fold expansion of facilities without major interference with existing services, railway sidings or test-houses. The factory is almost entirely on one level and covers some 340,000 sq ft. Some 40,000 sq ft of this is devoted to the two-storey office building. Additionally the premises of the overhaul and supply division held on a short lease cover 65,700 sq ft, of which 3,600 sq ft are devoted to test beds.

All the latest practices in factory construction and equipment have been incorporated at the Jacques Cartier factory. The four test-beds are designed to be adaptable for larger radial engines and gas turbines. Three are used for production testing and one for test and development.

The directors of Canadian Pratt and Whitney, ten in number,

THE CANADIAN INDUSTRY . . .

are leading men in American and Canadian industry and, of course, the president, chairman and vice-chairman of C.P. and W.A. are numbered amongst them. The chairman of the board is James Young; the president R. T. Riley; the vice-president J. W. R. Drummond.

The company's activities are not today confined only to engines, but include sales, service and overhaul of products from two other United Aircraft Corporation divisions, namely, Hamilton Standard and Sikorsky. In addition, the Pesco Products Division of Borg-Warner Corp. is represented. The Pratt and Whitney engines which are the direct concern of C.P. and W.A. in Canada are R-985 Wasp Junior; R-1340 Wasp; R-1830 Twin Wasp; R-2000 Twin Wasp; R-2180 Twin Wasp; R-2800 Double Wasp; R-4360 Wasp Major.

For Hamilton Standard the following components are covered: propellers (Hydromatic); governors; synchronizers; air conditioning units; starters for gas turbines; hydraulic pumps and fuel controls for gas turbines.

Sales and field servicing facilities are provided for the Sikorsky 51 and 55 helicopters. It is expected that the volume of helicopter work will increase and provision has been made for limited airframe overhauls as well as for blades in the airscrew division, and engines and transmission in the appropriate section.

Pesco Products, handled by C.P. and W.A., are engine and electrically driven fuel pumps, hydraulic pumps, air pumps and valves.

To carry out this work the company is divided into three main divisions: manufacturing, overhaul and supply, and general and administrative. In all, rather more than 1,800 people are employed of which some 1,300 are in the manufacturing division, 330 in supply and overhaul and about 200 more are engaged on general and administrative duties.

Machining Wasp cylinder heads at Canadian Pratt and Whitney's new Jacques Cartier factory in the Montreal area.

ROLLS-ROYCE OF CANADA LTD.

FEW companies, if any, have longer aeronautical associations with Canada than Rolls-Royce, and the firm has been represented there since 1921. Many early flights in Canada which justify the description of "significant" were made with the aid of Rolls-Royce engines, and, of course, it was Eagle VIII engines which took Alcock and Brown across the Atlantic from Newfoundland to the British Isles.

The company concisely summarizes its own background as follows:—Rolls-Royce of Canada, Ltd., is a wholly owned subsidiary of Rolls-Royce, Ltd., Derby. The Canadian company is the successor to Rolls-Royce Montreal, Ltd., incorporated in 1947, and until early 1952 operated at Montreal Airport as a service and parts stores organization for Rolls-Royce aero engines.

Coincidental with a large jet engine contract, placed by Canada with the parent company in late 1951, Rolls-Royce, Ltd., decided to construct a manufacturing and assembly plant in Canada, financed by company funds. On February 25th 1952, ground was broken for the purpose of building this factory on Cote de Liesse Road, near Montreal Airport. About a year after this, work in the factory commenced, and as machinery was pregressively installed the tempo increased. By the beginning of 1954 overhauls of turbojets had commenced and components were being manufactured in considerable numbers.

Today the factory is fully equipped for the production and assembly of jet engines, for overhauls, testing and the manufacture of spare parts. Numerous sub-contractors help with the manufacturing work, and for the Nene it may be said that Rolls-Royce's main job is to make the fast-moving and hot parts and to assemble the whole unit.

Employees at the plant number between three and four hundred, all being skilled or semi-skilled. Most of these have been recruited locally, and only a few key men have been sent out from the U.K. It is Rolls-Royce experience that Canadians and recent immigrants quickly become skilled and are easy to train. The company is particularly proud of its seam-welding equipment. With the aid of its special control units, the speed of working achieved has been something like twice that achieved at home.

Engine test beds are connected with the main factory; the most modern equipment is installed, and particular attention has been paid to the silencing.

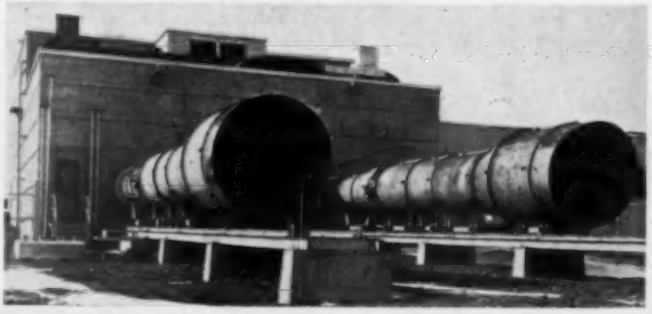
The establishment of this new Rolls-Royce company in Canada has in no way curtailed the activities of the outside technical representatives who continue to operate throughout Canada.

At this stage no great expansion is foreseen in R.-R. gas-turbine manufacturing activities in Canada because of the ample capacity for this work elsewhere in the country. The company is building, in effect, a token run of about fifty Nenes, showing that the potential has been established. The full Nene contract for T-33s, received by Rolls-Royce, Derby, is for 900 to the value of $33m. After completion of the order early next year spares will continue to be manufactured.

Aircraft engines constitute the largest and most important part of the Canadian activities, but the interests of the motor-car and oil-engine divisions are also looked after at the Montreal factory.

From the point of view of aircraft sales in Canada and the United States, it is very important that Roll-Royce are now in a position to offer gas turbine overhauls, service and spares in North America. The company also has a large service and spares commitment for its many other engines in use in Canada. The first T-33 Nenes are also back for overhaul after some 500 hours' running.

Lord Hives is president of the board of directors of Rolls-Royce of Canada, Ltd., and in addition to other Englishmen on the board there are three directors in Canada. They are R. M. Kendall, acting general manager; David Boyd, production manager; and Ian Turner, financial and commercial manager and secretary. Other executives in Canada are A. Cdre. E. R. Pearce, sales manager (aero); A. G. Morrall, manager, motor-car division; R. H. Whiteside, manager, oil-engine division; and James Hall, manager, aero engineering services department.



(Left) The neat and attractive Rolls-Royce plant outside Montreal. (Above) Detuners are employed for the well-equipped new R-R. gas-turbine test-beds.

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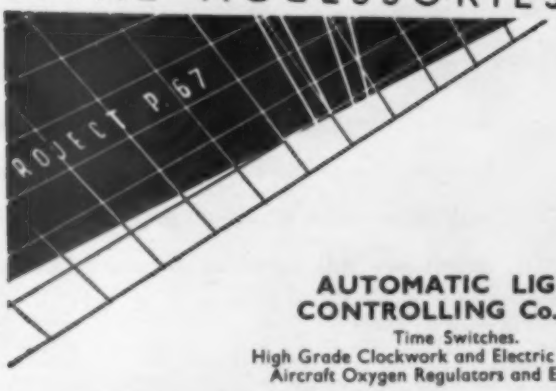

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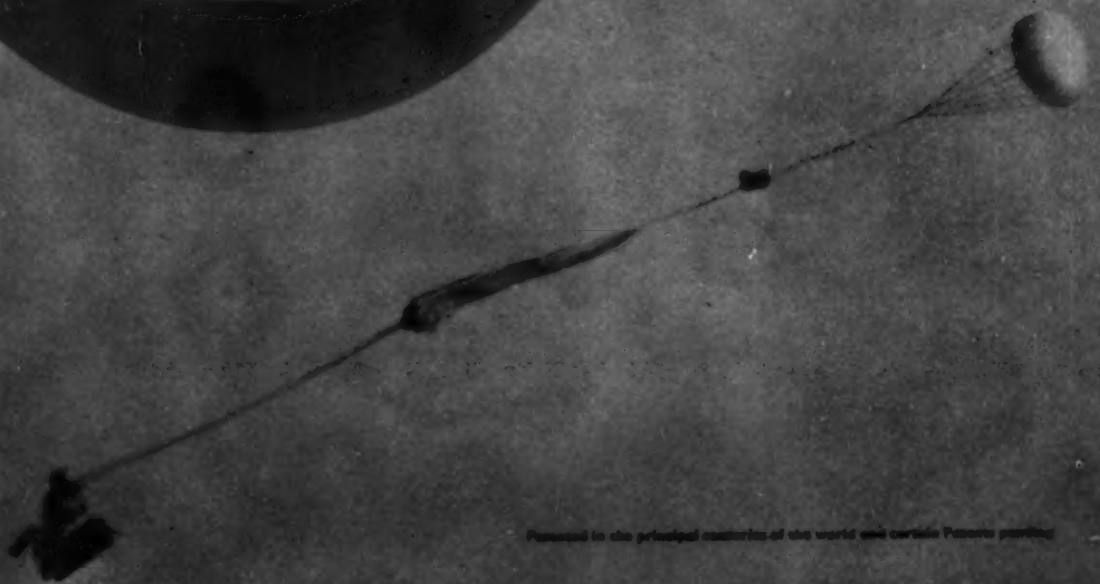

Protected in the principal countries of the world with certain Patents pending

At Chalgrove, Oxfordshire, England, an ejection was made with a Martin-Baker Fully Automatic Ejection Seat from a Meteor 7 aircraft flying at a speed of 600 m.p.h. and at a height of 150 feet. Three seconds after ejection the main parachute was fully developed 80 feet above the ground. The Martin-Baker Patent Fully Automatic Ejection Seat is manufactured in the North American continent by Canadian Flight Equipment, Ltd.

Canadian Flight Equipment, Limited

COBOURG ONTARIO CANADA

The world's only twin jet trainer with side-by-side seating

CHOSEN BY THE ROYAL AIR FORCE

ROLLS-ROYCE AVON JET ENGINES

'ENGLISH ELECTRIC'
Canberra
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Designed and built by
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AIRCRAFT OF THE COMMONWEALTH—1954

BELOW and on the following seven pages are described the fourteen most important types of aircraft which are at present being made in the aircraft factories of the British Commonwealth. Some of these aircraft are basically of British design, but are built in the Commonwealth in a form specially adapted to local requirements; some, again, are of American origin, while many are wholly indigenous, having been designed and developed in either Canada or Australia (or, in one case, in India, for the latter, although now a republic, is a member of the Commonwealth).

The British family of nations embraces every type of topography and climate in the world; it is, therefore, by no means easy to produce any machine as complex as an aircraft which will prove suitable to the needs of the whole family. For example it has usually been impracticable for a country like Australia to adopt a fighter developed for the defence of the British Isles, for such an aircraft would seldom have the radius of action needed for Australasian operations. By the same token, Canada is finding uses for large numbers of single-engined transports and civil helicopters of types for which there is only a small British requirement. This is partly because Canada, and other parts of the Commonwealth for that matter, use aircraft for many tasks which are handled in Great Britain by our roads and railways; in other cases the tasks themselves are different. Generally speaking, the more "outback" the region and the greater the distances involved, the more important have aircraft become.

Subjects as basic as national economics, transport and defence are studied in the Commonwealth on a collective basis. It is neither possible nor desirable for any member of the Commonwealth to adopt an isolationist attitude, neither can any member safely rely in emergency upon any other, or upon the United Kingdom, for a vital type of aircraft—as Australia, at least, learned in World War 2. No Commonwealth country is sufficiently large or industrially developed (yet) for it to be self-sufficient in aeronautical affairs. Yet, in the types of aircraft most vital to each country, self-sufficiency is being sought, as the following pages show.

AUSTRALIA

7,500 lb-thrust	C.A.C.-built Avon
Span	37ft 1in
Length	37ft 6in
Gross weight	about 17,000 lb
Maximum speed	about 700 m.p.h.

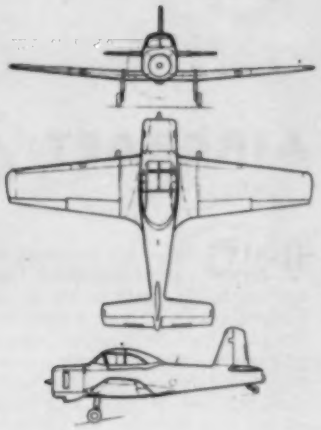
COMMONWEALTH CA-27 SABRE In the summer of 1951 all previous Australian plans for future fighter production were scrapped, and the decision was taken to manufacture the North American Sabre under licence. This was already a battle-proven aircraft and it had the range necessary for the defence of the Australian continent.

The American company co-operated closely with Commonwealth Aircraft, and made available not only drawings and design data but also detail assemblies, tools and jigs. As a result, the first Australian-built Sabre was completed within 22 months of the decision to adopt the type.

Nevertheless, C.A.C. did very much more than merely build an American aircraft. From the outset, it had been Australian policy to cure two deficiencies in the original F-86A and E that had manifested themselves in Korea: lack of power and lack of a heavy-calibre combat punch. To cure the first fault, the Australian Government looked to Rolls-Royce, whose Avon was then already showing exceptional promise; to cure the second, the six 0.5in guns were replaced by a pair of the then-new 30 mm Aden cannon, the most potent aircraft guns ever developed.

As a result of these, and other, modifications, the CA-27 is quite different from any other Sabre, and is also at least on a par with any other type of F-86 from the combat viewpoint. The whole fuselage has been redesigned to accept the fatter, yet shorter, Avon, together with the larger intake ducting required. The Avon is actually mounted farther aft than was the previous engine, since the British unit is some 400 lb lighter in spite of giving 50 per cent more thrust. The engine used is actually very similar to the British RA.7, of 7,500 lb thrust.

The prototype Avon-Sabre began its very succesful trials on August 3rd, 1953. Production CA-27s, of which nearly 100 are reported to be on order, are assembled at the new airfield at Avalon, near Geelong, Victoria.



COMMONWEALTH CA-22 WINJEEL This side-by-side machine was initially designed around the 455 h.p. Pratt and Whitney Wasp Junior. Like the Provost—with which it may be compared—the Winjeel has a low wing, a fixed tailwheel-type undercarriage, a roomy cockpit with central control pedestal, v.h.f. radio, and an all-metal structure. The engine is housed beneath a petal-type cowling, which bares the whole installation for maintenance, and the entire fuselage is liberally provided with hinged panels to facilitate access to interior equipment and control runs.

The prototype Winjeel was exhaustively evaluated by the R.A.A.F. and adopted as a standard type. Orders were placed for a sizeable number, and construction has been spread widely throughout the Australian industry—a decision which, in conjunction with the simple tooling required for such a type, has resulted in there being a very considerable production potential for the Winjeel ready in case of any emergency.

The first batch of Winjeels, at least, are provided with a third seat mounted directly behind the right-hand front seat; this seat is intended for passengers and follows an idea which was originally put into practice with early British Prentices and was later abandoned. If required, the Winjeel interior can be converted to carry one stretcher patient and attendant. Aircraft No. 30, and all subsequent machines, are scheduled to be powered by the Australian Cicada engine, which generally resembles the Wasp Junior (p. 297).

455 h.p.	Pratt and Whitney Wasp Junior
Span	38ft 9in
Length	28ft 10¼in
All-up weight	4,235 lb
Maximum speed	187 m.p.h.

AUSTRALIA

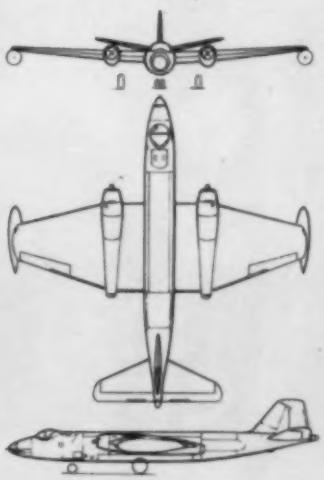
Two C.A.C.-built Rolls-Royce Avons	
Span	63ft 11½in
Length	65ft 6in

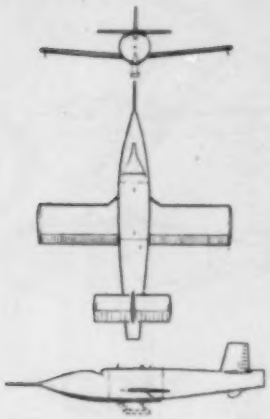
D.A.P. CANBERRA The Department of Aircraft Production decided in 1950 that, following completion of current contracts for the Avro Lincoln, the Government Aircraft Factory should manufacture the English Electric Canberra for the R.A.A.F. With the assistance of the English Electric Company, tooling proceeded rapidly, the work being spread among a number of sub-contractors, and engines being manufactured by Commonwealth Aircraft.

The initial order was for 48 aircraft. The first Australian-built Canberra flew on May 29th last year; two participated in the London-to-Christchurch race last October (coming in second and fifth) and about a dozen have now been delivered.

Known as the Canberra B.20, the Australian machines are three-seat tactical bombers derived from the British B.2, and with almost identical capabilities. There are, however, numerous differences in detail in such items as radio and instrumentation and also in operational equipment. Initially the B.20s are powered by Commonwealth-built (Rolls-Royce licence) Avons of RA.3 rating; later machines will have engines equivalent to the RA.7 (and thus similar to those used in the Commonwealth Sabre). The three-view drawing shows a B.20 with engines of this type.

The present production rate is maintained at a nominal level to suit the requirements of the R.A.A.F. in peacetime; there is, however, a considerable potential production several times greater than this. The current Canberra project is scheduled to continue through 1957, including later marks of Canberra (Mk 21 to Mk 24 inclusive).





D.A.P. JINDIVIK In order to shorten development time of this pilotless aircraft, a piloted version was first built, powered by an Armstrong Siddeley Adder turbojet, and fitted with a conventional land undercarriage. This was the first Australian-designed jet aircraft to fly (in October 1950) and, with the name Pika, has since been built in limited numbers and has proved most valuable in assisting development of the Jindivik.

Two types of Jindivik have been developed, the Adder-powered Mk 1 (12 built) illustrated above and the Viper-powered Mk 2, shown in the drawing. Engine air is taken in above the fuselage, behind the equipment bay in the nose. The take-off is effected from a special trolley, the landing being made on a retractable belly skid. Control is effected by a radio receiver, interpreter and auto-pilot, with a transponder to increase the range at which the aircraft can be tracked. British auto-stabilizing equipment is fitted; firms involved include McMichael and Elliott Brothers.

Construction is all metal, and particular emphasis has been placed on ease and cheapness of manufacture and assembly and metal-to-metal glueing is employed. The wing has no sweep, but the thickness/chord ratio was no more than 10 per cent in the Jindivik Mk 1 and has been reduced to six per cent in the Jindivik Mk 2, the latter also having the much more powerful Armstrong Siddeley Viper turbojet. As a result the Mk 2 is almost transonic.

Production Jindiviks are used at the L.R.W.E. Woomera, and developed Jindiviks are expected to remain in production for some years.

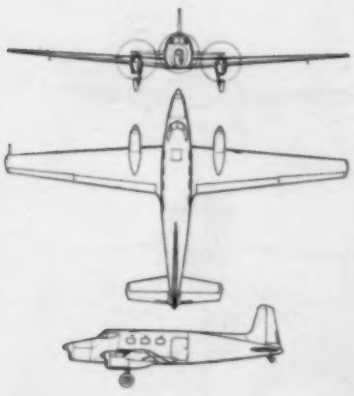
Armstrong Siddeley Viper

Span	19ft
Length	23ft 3¾in

AUSTRALIA

Three 145 h.p. D.H. Gipsy Major 10

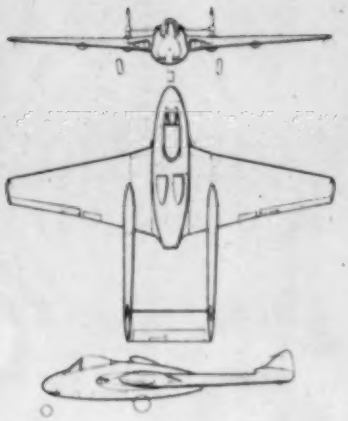
Span	57ft
Length	36ft 2in
Gross weight	8,500 lb
Cruising speed	about 130 m.p.h.



DE HAVILLAND DROVER D.H. Australia's only post-war design is the D.H.A.3 Drover, the prototype of which first flew in 1948. Limited production began the following year and the first Drover to go into service began its working life as a freighter in New Guinea on the strength of Qantas Empire Airways.

The Drover is almost unique in being a post-war three-engined aircraft. The power units are D.H. Gipsy Major 10s and, although they were originally intended to drive v.p. airscrews, these proved unsatisfactory and Drovers now have Fairey-Reed fixed-pitch metal airscrews. To regain the good take-off and climb, double-slotted flaps are being fitted. Cruising speed will probably be little impaired when modification is completed. The wing and much of the fuselage structure are, basically, almost identical with those of the Dove; the undercarriage, however, is of the tailwheel variety and is fixed. This has permitted hydraulic and pneumatic services to be eliminated, and only the most elementary electrical system is required.

The cabin is fitted to accommodate up to eight passengers, although most Drover operations concern the carriage of freight or ambulance patients. It is, in fact, in the Flying Doctor Service operated by Trans-Australia Airlines that the Drover is finding itself particularly valuable. Two stretcher patients can normally be carried, with medical attendants and equipment, including a sink. Compared with previous Flying Doctor aircraft, the Drover is proving very popular on account of its ability to climb to some 12,000ft if necessary, so avoiding turbulence and enabling the patient to sleep.



DE HAVILLAND VAMPIRE The aircraft shown in the three-view drawing is the Vampire F.B.30, which was developed and manufactured by de Havilland Aircraft Pty., Ltd., of Bankstown, New South Wales. Basically a single-seat Mk 5, the Australian variant is powered by a Nene 2-VH turbojet manufactured by Commonwealth Aircraft under licence from Rolls-Royce. This engine, which embodies numerous magnesium-alloy components to save weight, is about 50 per cent more powerful than the Goblin fitted to British Vampires, and results in a notable increase in all-round performance. To serve the double-sided compressor an additional pair of intakes is provided on the rear fuselage decking.

A total of 80 Vampire 30s has been built, and all have been confined to service within the Australian mainland. It is, with the Mustang, the standard fighter-bomber of the R.A.A.F. and Citizen Air Force—with the exception of the famous 77 Squadron, of Meteor 8s.

The photograph shows the first of an initial order of 36 Vampire Trainers which are being built at Bankstown for the R.A.A.F. and Royal Australian Navy. Virtually identical with the British Vampire T.11 and T.22, the later production Australian Vampire Trainers will have the extended dorsal fins and clear-vision canopy now standard on the type.

The initial batches of these aircraft were assembled in 1952 and early 1953 from Australian-built wings, booms and tail units, the wooden fuselage nacelles being imported from England. British-made Goblins are being used on all aircraft.

[illegible] lb-thrust	G.A.C.-built Nene 2-VH
Span	[illegible]
Length	31ft
Gross weight	about 11,000 lb
Maximum speed	about 570 m.p.h.

AUSTRALIA

CANADA

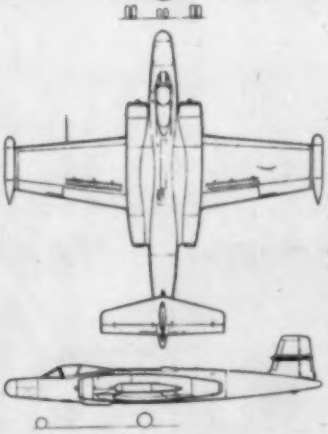
Two 7,[illegible] lb-thrust Avro Orenda 11	
Span	[illegible]
Length	[illegible]
Gross weight	about 40,000 lb
Maximum speed	about 660 m.p.h.

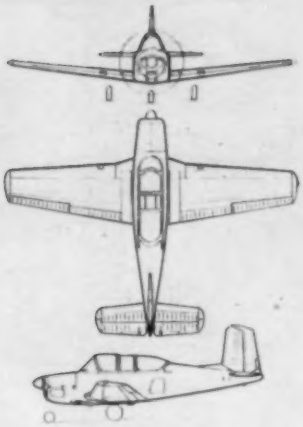
AVRO CANADA CF—100 The prototype of the eventual Avro Canada CF-100 first flew at the beginning of 1950; the type has since been considerably developed.

One year ago, 83 prototypes, pre-production Mk 2s and production Mk 3s had been delivered, and these were then followed by the more powerful Mk 4, deliveries of which began last autumn, and are being maintained on schedule; already a considerable proportion of the total order of some 600 has been delivered.

The Mk 4 is powered by two Avro Canada Orenda 11 turbojets, each of some 7,500 lb thrust. The 54ft fuselage carries a radar-directed fire-control system in the nose, which is supplied as a unit by Hughes Aircraft of California. The pilot and navigator sit in tandem ejector seats in the air-conditioned and pressurized cockpit, and the centre fuselage houses a very large quantity of fuel. In the belly is a bay for a quickly removable pack containing either eight 0.5in guns and ammunition or a number of 2.75in unguided air-to-air rockets. A total of 104 other air-to-air rockets can be carried in streamlined pods at the wing-tips, as an alternative to a total of from two to 12 guided weapons, according to the type employed. This armament is the heaviest of any fighter in service.

The airframe is de-iced by electric heater mats, and the engines have alcohol sprays on the intake cone "spinner." A Dowty twin-wheel undercarriage is fitted. Finally, it is noteworthy that, in spite of the CF-100's great bulk and lack of wing-sweep, the airframe is so strong and the control system so good that supersonic speed can be attained in a dive.





CANCAR MENTOR The Beech Model 45 Mentor is a tandem-seat military pilot-trainer which bears a family resemblance to the Bonanza. Adopted as the T-34A by the U.S.A.F., it is the standard primary trainer of that service and has also been selected for the U.S. Navy in the same rôle. T-34As are being made by CanCar at Fort William, and initially all are for the U.S.A.F. Some 200 are on order from the Canadian company.

The structure is a conventional stressed-skin assembly, and in spite of the emphasis placed on simple tooling and general ruggedness the external finish is very good, flush riveting being used throughout. Control surfaces are of magnesium alloy and the flaps and nose-wheel-type undercarriage are operated electrically. The nose wheel is steerable and the main units have hydraulic disc brakes.

The Continental flat-six engine drives a two-blade metal constant-speed airscrew and is supplied with fuel from two wing tanks with a total capacity of 50 U.S. gallons. The cockpit is exceptionally well equipped, and is heated and air-conditioned. Radio, defroster and adjustable seats are standard. The Mentor is not, however, normally used for armament training and there is no U.S.A.F. requirement for an under-wing load.

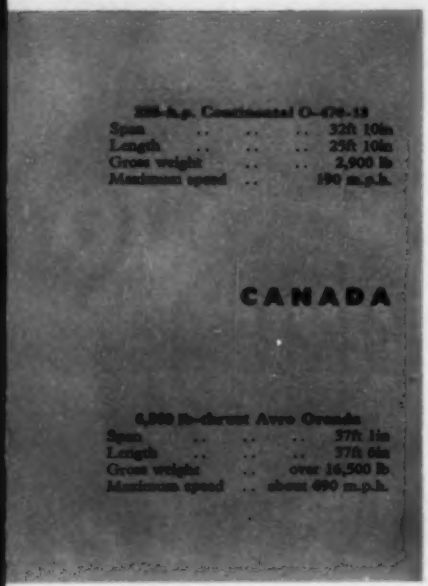
It has been estimated by the parent company—Beech Aircraft of Kansas—that, if a Mentor and Harvard were each used for five hours per day over a five-year period, the former machine would consume some 150,000 gallons less fuel.

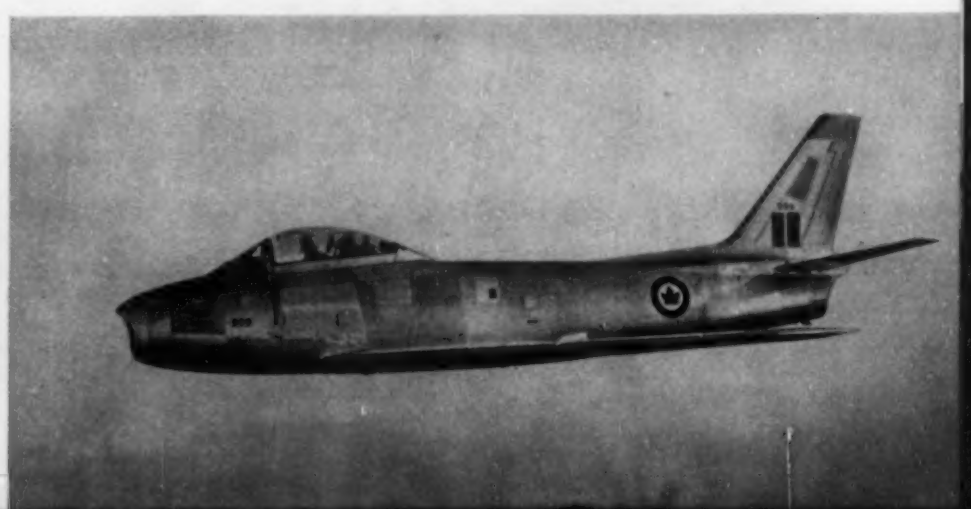
CANADAIR SABRE In the early part of 1949 the North American Sabre was adopted as the future standard single-seat fighter of the R.C.A.F. In August of that year an initial order for 100 Sabres, of the F-86A type, was placed with Canadair, and tooling was commenced, with the assistance of the American company.

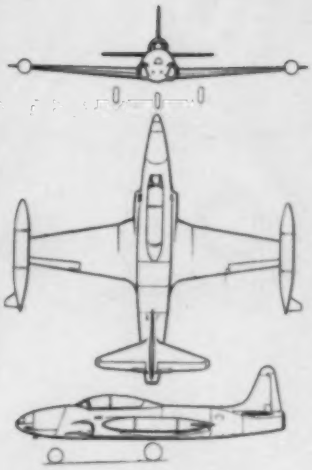
The first aircraft was delivered in July 1950 and, since that date, Canadair's Sabre production has been one of the brightest spots in the Commonwealth's aeronautical scene; the original order has, of course, since been multiplied many times. In 1951 the F-86E machine succeeded the "A," the new type having the all-flying powered tailplane; the next major modification concerned the cabin-air system; in 1953 the "6-3"-leading-edge wing was adopted, with increased chord and no slat; and later that year (with some 800 J47-powered machines delivered) a switch was made to the Avro Orenda engine, of some 30 per cent greater thrust.

The present total output amounts to some 1,200 aircraft, of which some 400 are J47-powered Sabre F.4s of the R.A.F. and about 350 are Orenda-powered Sabre 5s serving with the R.C.A.F. No. 1 Air Division in Europe. The latter have been replacing earlier Sabres which have, in turn, been given to other NATO nations (such as Greece and Turkey) together with extensive spares. At least 50 Canadair J47 Sabres have been supplied to the U.S.A.F.

The present Sabre 5 has the 6,500 lb-thrust Orenda 10, and the later Sabre 6 has a more powerful Orenda 14, with two turbines. These aircraft have been described as being unexcelled in high-altitude combat performance by any other type of fighter in service.







CANADAIR SILVER STAR The considerable expansion of Canadian pilot-training schools since 1952 is absorbing numerous Lockheed T-33ANs, of basically American design, built under licence by Canadair with the above name.

The prototype T-33 was a Shooting Star fighter modified to accommodate an additional seat, at some expense in fuselage tankage. Instructor and pupil were arranged to sit in tandem beneath a long, frameless canopy, hinged at the rear and opening by an electric screw-jack. The nose armament was reduced to two 0.5in guns, but all the other equipment of the Shooting Star can be carried, including an underwing offensive load and wing-tip fuel tanks of 230 U.S. gallons each.

For Canadian purposes a number of modifications were made, the most important of which was the selection of the Rolls-Royce Nene as the standard power unit, a change which did not involve extensive structural alteration and greatly improved take-off and climb performance. The Nene 10s used are mainly British-made to date, but Rolls-Royce of Canada are supplying later engines.

The initial order for the aircraft—designated T-33AN and named Silver Star—was placed in August 1951. Tooling proceeded extremely rapidly and the first machine was delivered at the end of 1952. Output increased to a peak of two Silver Stars per day (reduced since the cease-fire in Korea) and about 350 have so far been delivered. A total of 576 is on order for the R.C.A.F., although the total Canadair output is expected to be at least 900.

[redacted]
Span ... 38ft 10¼in
Length ... 37ft 9in
Gross weight ... about 12,000 lb
Maximum speed ... 600 m.p.h.

CANADA

140 h.p. D.H. Gipsy Major 1c
Span ... 34ft 4in
Length ... 25ft 5in
Gross weight ... 1,930 lb
Maximum speed ... 140 m.p.h.

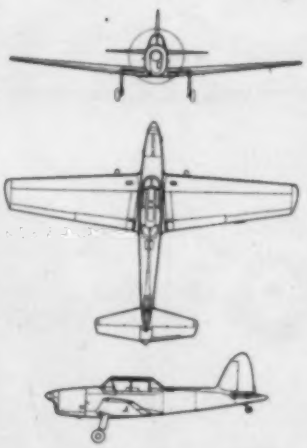
DE HAVILLAND CHIPMUNK The first Canadian de Havilland design was developed by M. Jakimiuk shortly after World War 2, the aim being to achieve a rugged replacement for the Tiger Moth. From the outset it was intended as a military trainer, and no attempt was made to make it available as a private touring aircraft.

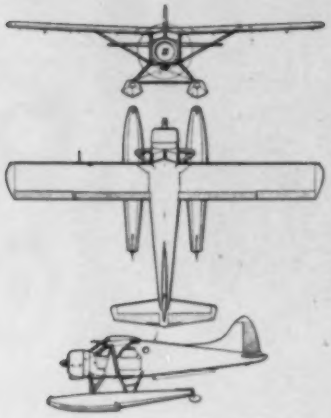
The prototype first flew in May 1946, and production deliveries began the following September. Since then 158 Chipmunks have been delivered from the Canadian factory.

These aircraft have a 140 h.p. D.H. Gipsy Major 1c driving a fixed-pitch airscrew. An all-metal stressed-skin structure is employed, of a type rarely seen in light aircraft. This has made the Chipmunk expensive to buy, but has certainly been worth while in preventing much superficial damage, and in preserving the aircraft in severe climates.

The pilot and pupil sit in tandem beneath a large sliding canopy, which in some Canadian machines is of the frameless "bubble" type. Canadian Chipmunks have been fitted with a ski-type undercarriage (as shown in the photograph) and at least one machine has been re-engined with an American flat-four.

The type has also been manufactured (to a total of nearly 1,000 aircraft) by the Chester, England, factory of the English parent company. Designated Chipmunk T.10, these British machines have the more powerful Gipsy Major 10, with a cartridge starter, and differ from the Canadian version in instruments and equipment.





DE HAVILLAND BEAVER Shortly after the end of the second World War, the D.H.C.2 Beaver was designed to take over the multifarious "Bush-flying" jobs then undertaken by a diversity of pre-war and ex-military aircraft. Overriding importance was placed on "ruggedness," ease of maintenance, reliability, carrying capacity—from the aspect of both weight and bulk—and flexibility and short-field performance.

The design was a winner from the start, for it offered 120 cubic feet of stowage space and could carry well over half-a-ton; furthermore, it has proved eminently suitable for conversion to skis and floats, and can fly smoothly with such loads as large canoes (too bulky for internal stowage) lashed to the landing gear or floats. The wing has a high aspect ratio, and is fitted with hydraulically actuated slotted flaps and drooping ailerons. A controllable-pitch two-blade airscrew is standard, and the full-load take-off and landing distances are both of the order of 1,250ft. The heated cabin can accommodate seven passengers.

More than 600 Beavers have left the Downsview factory to date, and production continues at a rate of some 15 per month. A Leonides-powered variant has also been developed, for possible production in England to meet the needs of sterling customers or others who prefer this more modern and more powerful engine.

DE HAVILLAND OTTER The great success of the Beaver led its makers to explore the field even further and it became evident to the D.H. Canada design and sales staffs that a market existed for a machine of similar layout but capable of carrying about twice as much. Early in 1951 the final plans were drawn up for the D.H.C.3, originally named King Beaver and now familiar as the Otter. Although it generally resembles the Beaver the Otter is very much larger and can, in fact, carry 15 passengers. The engine is nothing more potent than the reliable 600 h.p. Wasp, and the resulting power loading of nearly 13 lb/h.p. has necessitated the development of an exceptionally efficient airframe.

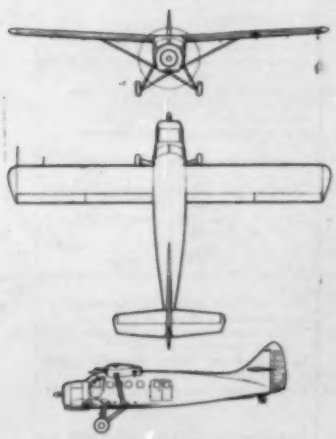
Slotted ailerons and double-slotted flaps provide a remarkable take-off performance, and float and ski undercarriages have been developed. Four doors are fitted (one nearly four feet wide) and the strong cargo floor embodies a parachuting hatch. All the experience with the Beaver has been incorporated, and the Otter is proving very adaptable to work in completely undeveloped regions.

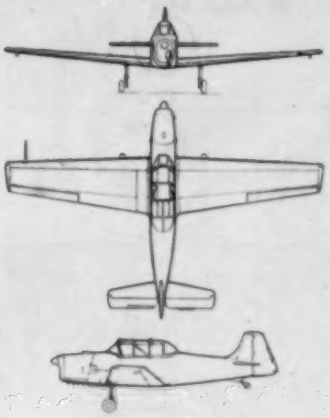
A point of interest is that the Otter is rather larger than the Dove; in particular, the usable cabin volume is one foot longer and considerably wider and higher. Aerodynamic efficiency is enhanced by the very neat engine installation, the only air exit from the cowling being from annular orifices surrounding the exhaust pipes, so that a powerful injection effect draws cooling air past the Wasp with minimum drag. The double-slotted flaps have made possible the attainment of a lift coefficient which is almost unmatched by any other aircraft in general use, and the stalling Otter can be flown, at low altitude but with full load, at no more than 50 m.p.h. under full control.

600 h.p. Pratt and Whitney R-985
Span ... 46ft
Length ... 30ft 4in
(32ft 9in as floatplane, above)
Gross weight ... 4,820 lb
Maximum speed ... 164 m.p.h.
(150 m.p.h. with floats)

CANADA

600 h.p. Pratt and Whitney R-1340
Span 58ft
Length 41ft 10in
Gross weight 7,600 lb
Maximum speed ... 160 m.p.h.
(153 m.p.h. with floats)





HINDUSTAN HT-2 Designed by Dr. V. M. Ghatage, the HT-2 is the first aircraft of wholly Indian origin to be put into production. Intended for both military and civil basic training, it is powered by a 155 h.p. Cirrus Major III driving a fixed-pitch wooden airscrew, and is thus rather more powerful than the generally similar Chipmunk; it is, however, some 300 lb heavier than the Canadian machine.

Instructor and pupil are seated in tandem, each cockpit having its own sliding canopy. The airframe is entirely of metal, and exterior riveting is generally flush. The fixed undercarriage employs oleo-pneumatic shock absorbers and hydraulic disc brakes. Each inner wing houses a 13-gallon fuel tank, but no provision is made for an external load to be carried. Split flaps are fitted, and light v.h.f. radio can be carried, there being a whip aerial on the rear fuselage decking.

Production of the HT-2 is being maintained at a level matched with the needs of the Indian Air Force, in which Service it is the standard basic trainer. A production machine is shown on p. 290. Hindustan also have a more powerful advanced trainer under development.

155 h.p. Hindustan Cirrus Major III	
Span	35ft 2in
Length	24ft 9in
Gross weight	2,240 lb
Maximum speed	130 m.p.h.

INDIA

AIRCRAFT of the COMMONWEALTH — 1954

	Power Unit(s)			Span (ft)	Length (ft)	Gross Weight (lb)	Max. Speed (m.p.h.)	Typical Load or Operational Equipment	Remarks
	No.	Type	Total power *						
AUSTRALIA									
D.A.P. Canberra B.20	2	C.A.C. Avon ...	13,000	64	66	—	—	—	In production.
D.A.P. Lincoln B.30 ...	4	C.A.C. Merlin 102...	7,000	120	84	82,000	290	Various, up to 22,000 lb.	Total of 73 built. Length is 6ft greater after modification for anti-sub recce.
D.A.P. Pika	1	A.S.M. Adder ...	1,100	19	23	—	—	Pilot and small amount of test gear.	Development prototype only.
D.A.P. Jindivik 2 ...	1	A.S.M. Viper ...	1,900	19	23	—	—	Radio-governed autopilot.	In production. High subsonic speed.
CA-22 Winjeel ...	1	P & W R-985 ...	455	39	29	4,235	187	Three seats, 72 gal fuel.	62 on order. From No. 30 all will have Cicada engine (p.297).
CA-27 Sabre	1	C.A.C. Avon ...	7,500	37	38	17,000	700	Two 30 mm guns, underwing racks.	In production.
D.H.A.3 Drover ...	3	G. Major 10 ...	435	57	36	6,500	140†	Six/eight passengers.	No longer in production.
D.H. Vampire F.B.30	1	C.A.C. Nene ...	5,000	38	31	11,000	570	Four 20 mm guns, plus 2,000 lb underwing load	80 built for R.A.A.F.
CANADA									
Avro Canada CF-100-4	2	Avro Orenda 11 ...	15,000	52	54	40,000	660	104 rockets and eight 0.5in guns.	In production.
Avro Canada CF-102	4	R-R Derwent ...	14,400	98	82	65,000	450†	12,700 lb payload.	One prototype only, built 1949.
Avro Canada CF-105	2	Avro Waconda (?)	30,000†	—	—	50,000†	M=1·5†	Guided weapons.	Development contract; prototype to be built. Will have delta wing.
Canadair C-4 ...	4	R-R Merlin 720-6 ...	7,040	117	94	82,300	320	About 15,000 lb or 40 seats	72 built, civil version pressurized.
Canadair C-5 ...	4	P & W R-2800 ...	9,000	117	94	86,000	340	About 18,000 lb.	One only. V.I.P. transport.
Canadair Sabre 4 ...	1	J47-GE-27	5,800	37	38	16,000	670	Six 0.5in guns.	About 800 built, 370 for R.A.F.
Canadair Sabre 5 ...	1	Avro Orenda 10 ...	6,500	37	38	16,000	690	Six 0.5in guns. Underwing stores.	In production; about 300 delivered.
Canadair Silver Star	1	R-R Nene 10 ...	5,100	36	38	12,000	600	Two 0.5in guns. Dual control.	In production; about 350 delivered.
Canadair CL-27 ...	4	Wright R-3350 ...	14,800	141	120†	150,000†	400†	Various offensive stores internally.	Development of Britannia. Gradual production until 1961.
CanCar Harvard 4 ...	1	P & W R-1340 ...	550	42	30	5,617	210	Two seats.	550 built since 1945, some for U.S.A.F. as T-6G Texan.
CanCar Mentor ...	1	Continental ...	225	33	26	2,900	190	Two seats. Radio.	About 200 for U.S.A.F. as T-34A; possibly for R.C.A.F. later.
D.H.C.1 Chipmunk ...	1	G. Major 1c ...	140	34	25	1,900	140	Two seats. 742 lb disposable.	Total of 158 built; about 900 more from U.K.
D.H.C.2 Beaver ...	1	P & W R-985 ...	450	48	30	4,820	164	Up to seven seats.	In production; about 620 delivered.
D.H.C.3 Otter ...	1	P & W R-1340 ...	600	58	42	7,600	160	Up to 17 seats.	In production; about 40 delivered.
D.H.-built S2F (Grumman design) ...	2	Wright R-1820 ...	3,000	—	—	—	—	Four seats, weapons and radar	To be manufactured in Canada, D.H. being "prime contractor."
Fleet-built Courier ...	1	Lycoming	260	39	30	2,800	157†	900 lb. (agricultural 1,600).	Licence from Helio Aircraft Corp. Agricultural weight 3,800 lb.
Fleet-built LZ-5 ...	1	Lycoming SO-580-D	400	48‡	38‡	5,000	98	2,140 lb or six passengers.	Licence from Doman Helicopters, Inc.
INDIA									
Hindustan HT-2 ...	1	Cirrus Major III ...	155	35	25	2,240	130	Two seats.	In production for I.A.F. Available for export.
Hindustan HT-10	1	P & W R-1830	1,050	44	33	8,500	230†	Two seats side-by-side.	Prototype being built.

* Pounds thrust or horsepower; † Estimated value; ‡ Rotor diameter and fuselage length.

Specially painted for Armstrong Siddeley, Roy Nockolds' abstract design portrays the tremendous power/speed potential of the Sapphire turbojet.

Chosen to power an impressive list of aircraft for the air forces of the N.A.T.O. powers — the Sapphire develops over 8,000 lb. thrust. With its small frontal area, resulting from an annular combustion chamber, the Sapphire blends well into the aerodynamic forms of supersonic aircraft.

★ ***THE SAPPHIRE*** *is being manufactured under licence by the Wright Aeronautical Division of the Curtiss-Wright Corporation in the U.S.A., where it is known as the Wright J-65.*

The Hawker
HUNTER *F.2 fighter*

The Gloster
JAVELIN *all-weather fighter*

★ *The Republic F.84F*
THUNDERSTREAK *fighter*

The Handley Page
VICTOR *crescent-wing bomber*

★ *The*
MARTIN B57 *(Canberra) bomber*

★ *The North American*
FURY *fighter*

★ *The Douglas A4D*
SKYHAWK *bomber*

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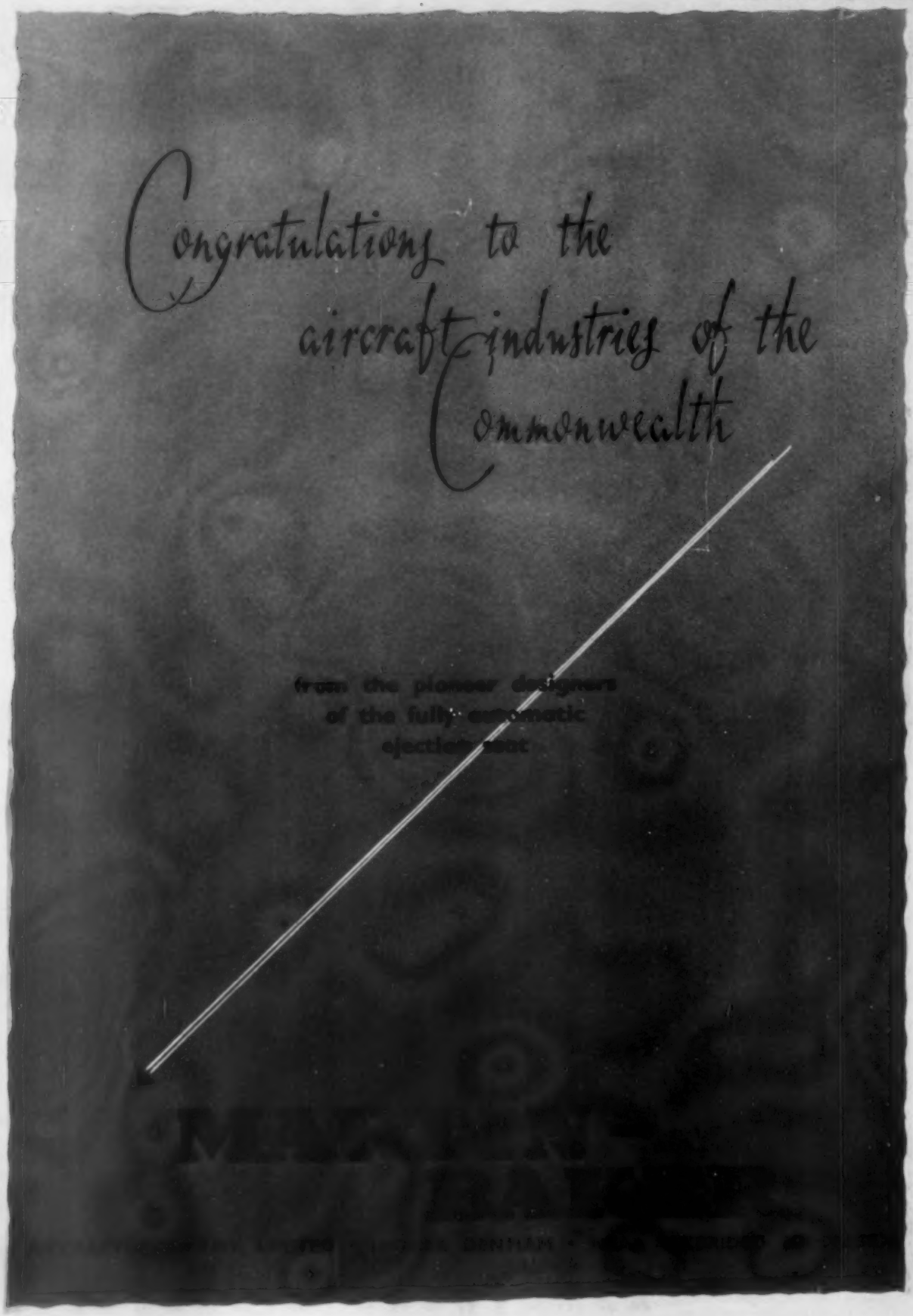
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MISSILES in the COMMONWEALTH

WHOEVER writes about guided weapons—for publication, that is—necessarily runs the risk of producing an unbalanced account, as the king-pins of the whole subject (the weapons themselves) cannot yet be referred to at all. Nevertheless, it is known that such things are being developed within the British Commonwealth.

Guided weapons are fearsome things, and they need a lot of space if they are to be experimented with safely. It was largely as a result of the fact that we live in a "tight little island" that led the British and Australian governments to hold discussions with a view to preparing a huge range in the Australian "outback" where all kinds of warlike developments could be tried out. It was in 1947 that the first real survey took place, and a few words about the region itself are appropriate.

From Adelaide, South Australia, the trans-Australian railway runs initially northwards, to the head of Spencer's Gulf; then it strikes west across the Nullarbor plain to Perth, 1,500 miles away. Between the Nullarbor plain and Adelaide, and 350 miles from the latter city, is a small junction named Pimba, and a spur line runs from here about eight miles to the head of the range, which has been named Woomera, an aboriginal word for a spear-throwing device. The range-line itself stretches away to the north-west for thousands of miles, crossing the Australian coast at Eighty-mile beach and carrying on across the ocean.

At the head of the range the ground is largely stony desert—or was, before Woomera was established. And yet it is not quite desert, for it has always supported a few sheep to the square mile, on enormous stations almost as large as England. These sheep stations are still there, of course, and missile firing has scarcely disturbed them. Farther out, in the interior, it becomes real grim desert. Throughout the range, there are no towns or hills, or anything which would adversely affect the use of the range; furthermore, the weather is almost continuously good.

In this vast region the Long Range Weapons Establishment was started, in 1948. The Establishment itself, of course, is almost entirely at one end, and centres about Woomera and Salisbury. The latter is a town about 15 miles north of Adelaide, where a £7m munition factory was built during the 1939-1945 war. This factory, with many newer buildings, now houses the technical organization acting as the "second line" behind the Woomera range itself.

The set-up is roughly as follows. The initial stage in the development of a guided weapon is to prepare a series of test vehicles, which are used to perfect the aerodynamics, guidance, structure, power unit and launching procedure. Test vehicles of both British and Australian design and manufacture have been fired at Woomera. Personnel and equipment (and, of course, missiles) come to Woomera from many parts of Britain, and also from Australian sources and from British factories in Australia; the latter are all located in the Salisbury region, and the firms involved include Armstrong Whitworth, Bristol, E.M.I., English Electric, Fairey (of Australia), Vickers Armstrongs and Sperry.

A daily R.A.A.F. air service links the two Long Range Weapon Establishments at Salisbury and Woomera.

Symbolizing guided-weapon development in the British Commonwealth is this photograph of an Australian-built rocket-test vehicle being fired at Woomera. The ground-scale is used for calculating acceleration during the boost phase.

The new Edinburgh Field, the aerodrome serving Salisbury, was opened by H.R.H. The Duke of Edinburgh during his recent visit to the L.R.W.E. Other airfields have also been built up at the range-head at Woomera, and the types of aircraft which may be seen there include Bristol Freighters and Sycamores, Australian-built Lincolns, Gloster Meteor 7s. The Meteors do a variety of jobs, one of which is to act as a "mother-ship" or shepherd to the radio-controlled Jindiviks.

There is, of course, very much more to the L.R.W.E. than the mere firing off of missiles. Regarding other trials, an American journal has asserted that "a new type of bomb for high-speed, high-altitude bombers" has been developed at Woomera, and that dropping trials took place from a special Lincoln with two Merlins and two Python turboprops, flying at 40,000ft. Research into clear-air gusts is reported to be another activity. The laboratories at Salisbury have, for several years, pursued such subjects as specialized electronics, optics, rocket propulsion, supersonic aerodynamics, control and guidance systems, and mathematical analysis and computation. All the work is conducted under the joint authority of the British Ministry of Supply and the Australian Department of Supply.

Salisbury itself is a perfectly normal town, with all the usual "essential services" laid on. Woomera was nothing at all when the work started, and the establishment of the range-head has been an immense task—and it was not made any easier by the fact that skilled labour is at a premium in the rapidly expanding economy of Australia. Some 5,000 men were in the labour force at one time, and the problems faced included the necessity of laying down a pipe-line to the Murray river, over 300 miles away, in order to provide a supply of water.

Today, Woomera is a permanent town of some thousands of people. There are churches, a school for 600 children, cinemas, tennis courts, swimming pools, stores (where, we are told, one may buy anything from a refrigerator to a boomerang), civil and Service messes and even a prison. Hundreds of thousands of trees have been planted which, when they are fully grown, will change the whole character of the region. For Woomera is built to last; it is an immense asset to the British Commonwealth, with its capability of handling long-range weapons.

Britain and Australia, although dominating the Commonwealth's guided-weapon research programme, have no monopoly in this field. Canada, also, has done a great deal of work, and has done it almost entirely on her own. Canada has a strong electronic and light engineering industry and she is pressing on rapidly with the development of at least one very promising guided weapon. It was inspected recently by the Duke of Edinburgh.

This is an air-to-air weapon, so a Woomera-type range is not required. Most of the initial theoretical study was carried out with electronic analogue computors, which examined the behaviour of a hypothetical missile tracking a hypothetical target. This basic development was largely done at the Canadian Armament Research and Development Establishment, at Valcartier, Quebec. The design of the weapon's airframe was entrusted to Canadair, Ltd., at Montreal, and some of the associated electronic work was the responsibility of Westinghouse.

At present, the complete missile has not been built, but most of the components and systems are in a reasonably advanced state of development. The basic shell of the weapon has been launched from the ground, using additional rocket boosters, and air launching has also been carried out, from a Sabre and possibly from other aircraft. It should not be very long before the missile can be launched complete with its guidance system, and it may then go into production for issue to Canada's home defence squadrons of Sabres and CF-100s.

Canadair-built North American Sabres of the Royal Canadian Air Force.

development of a vitally important class of aircraft and one, moreover, which, though first flown with British Rolls-Royce Avon turbojets, has been planned with the ultimate installation of Canadian Orendas in mind." We were gratified to see our remarks quoted by Canada's C.A.S. in a message to the R.C.A.F., and to this he appended his own observation: "I pass on this editorial to you because it is indicative of the thinking in other countries regarding the CF-100, and because it is encouraging to us to see this type of reaction from abroad."

Teamed with an ever-growing force of CF-100s is a vast chain of radar stations, and the Canadian writer Ross Willmot, in a recent contribution to our contemporary *Canadian Aviation*, expresses current Canadian thought in the following terms: "Of all the complicated jobs today's R.C.A.F. has undertaken probably none is more vital and more exacting in its new requirements than that of defending North America across the comparatively unexplored wastes of the roof of the world. It is a distinctly Canadian job and so it is most fitting that it should be the

THE COMMONWEALTH AIR FORCES

Present and Future Equipment, and Some Pertinent Factors

ELSEWHERE in this issue the principal types of aircraft manufactured or assembled in the factories of the Commonwealth are reviewed in considerable detail. Most of these are serving today, or will serve in future, alongside entirely British-built machines and some well-chosen importations from America. Here surveyed is the heterogeneous equipment of all the Commonwealth air forces and some factors influencing the composition of those arms.

The Royal Canadian Air Force

OF 3,000 or so aircraft operated by this progressive Service most are now jet-propelled and Canadian built; and of over 1,000 military aircraft delivered last year by Canadian companies, the greater part went to units of the R.C.A.F.

Having regard to Canada's heavy and diverse commitments, not only in her own territory but as a major contribution to NATO defence, the reason for the comprehensive variety of aircraft types in use or on order is readily understandable.

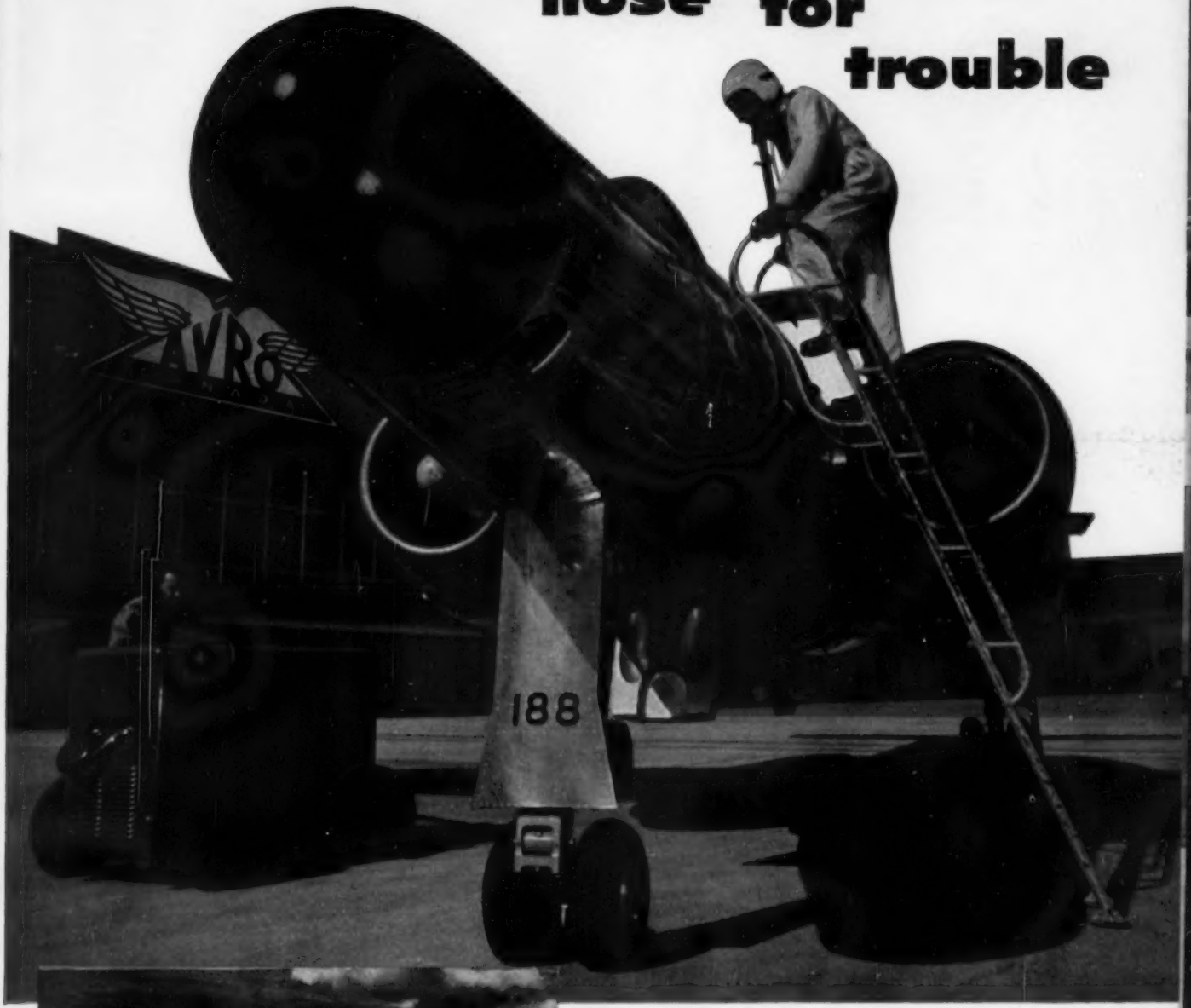
Of first-line machines the most characteristically Canadian is the Avro Canada CF-100 long-range all-weather fighter, of which we wrote in an editorial in 1950: "To Canada must go the credit for having initiated within the Commonwealth the responsibility of young men trained with Canadian methods and using Canadian designed and produced equipment. Like so many other present-day duties of the R.C.A.F. it is international in character, for the U.S.A.F. shares this role with the R.C.A.F. The Korean airlift, the air defence of Western Europe, sea-lane patrols in the Atlantic and Pacific and such world-wide transport flights as that of the Prime Minister, these, like CF-100 Arctic scrambles, are a far cry from the R.C.A.F.'s original jobs."

The standard single-seat day intercepter of the R.C.A.F. is now the Orenda-powered Canadair-built Sabre 5, and this type is in process of re-equipping all twelve R.C.A.F. squadrons on this side of the Atlantic. As the earlier J47-engined Sabre variants are displaced by the new machines, they are being transferred to other NATO countries as part of Canada's mutual aid programme for NATO. In addition, a considerable number of J47 turbojets are being transferred to other NATO countries as mutual aid, and a combined Canadian/U.S. mutual aid programme has already resulted in 370 Canadian-built Sabres being provided for the R.A.F. Though made in Canada, these have about 30 per cent American components.

The Sabre was preceded in R.C.A.F. service by the de Havilland Vampire and small numbers of these fighter/bombers remain on charge. The North American Mustang—which has

Serving Canada: Above, Avro Canada CF-100s; top right, Avro Lancaster; bottom left, D.H. Canada Otters; bottom right, Canadair North Star.

nose for trouble



The big black nose of the CF-100—and what's inside it—is truly a mark of distinction. For it identifies the all-weather interceptor from the day fighter and, in the case of the CF-100, as Canada's Aerial Defender against bomber attack across the North.

The "insides"—a complex mass of radar and electronic equipment—is designed to guide the CF-100 Mk. 4 unerringly to its target, lock on and destroy it with a formidable armament combination of rockets and guns. The effectiveness of this search and fire-control system is being demonstrated almost nightly during mock interception exercises by R.C.A.F. CF-100 squadrons based at strategic points.

With its twin Orendas, also designed and produced by AVRO Canada, the CF-100 Mk. 4 has a greater range and more power than any other fighter-interceptor in service anywhere. The Orenda also powers the Canadair Sabre 5, the outstanding day fighter in service today.

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The Orenda, like the CF-100, is a notable all-Canadian achievement, being a product of AVRO Canada's design and engineering staff. As the Orenda is developed to deliver still greater power, these engineering teams are also busy on other jetpowered projects for the future.

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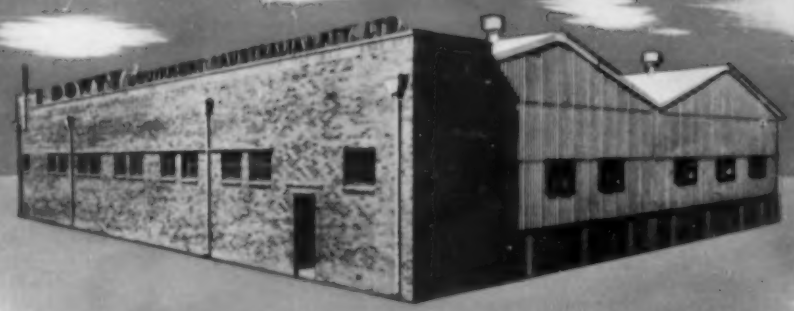

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American types in the R.C.A.F.: Left, Piasecki H-21; right, Canadair Silver Star (Nene-powered development of the Lockheed Shooting Star).

The Commonwealth Air Forces . . .

served the R.C.A.F. as faithfully as it has most other air forces of the world—continues in service only as a trainer and target tug.

The R.C.A.F. has no *bona fide* bombers, and the remaining North American Mitchells and Lockheed Venturas serve respectively as trainers and target tugs. It is worth noting, however, that the CF-100 has the makings of a formidable light attack-bomber, and may well appear in this role in years to come.

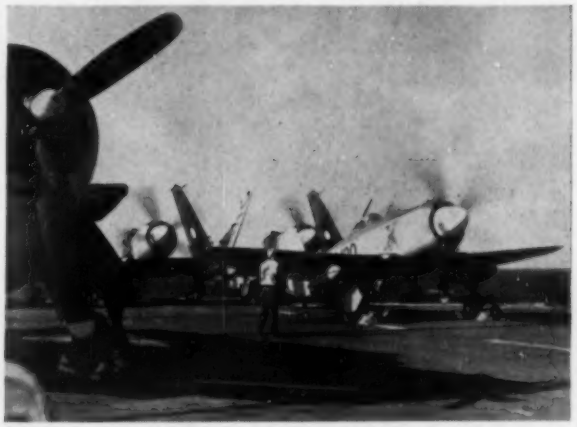
The two de Havilland Comet 1As supplied last year are intended for transport duties and for fighter and radar affiliation exercises.

For maritime reconnaissance, photographic reconnaissance and air/sea rescue, Avro Lancasters (built by Victory Aircraft), continue to serve, though they will eventually give place to the Canadair-built "M.R." Bristol Britannias and American-built Lockheed Neptunes. Out of a total of 50 Britannias foreseen, the initial contract for 13 is to be completed by 1961 and will be followed by separate contracts each calling for 12 aircraft. Of the Britannia order a Canadair director has said, "Everything we use from England must be 'North Americanized' to conform to required specifications, but we do not plan to change the basic philosophy of technical standards." He added that it was the desire of the U.S.A. to have the new aircraft designed and constructed in Canada as the U.S. Government did not wish to depend upon a European source of supply. "We hope to be able to find, and to solve," he added, "some of the problems Martin had" (obviously in reference to the Martin-built Canberra).

The first Neptunes are expected to be taken over by the R.C.A.F. towards the end of this year or early in 1955. Initially they will probably supplement the Lancasters, and their allocation to maritime squadrons will be on a priority basis. Canada's Minister of National Defence had said that consideration will have to be taken of the Dominion's NATO commitments, which involve the maritime squadrons operating from east-coast bases.

As a patrol amphibian the Canso (Canadian Vickers and Canadian Boeing-built amphibian Catalina) remains in service, and the Grumman Goose is a standard transport amphibian. The Auster A.O.P.6 (36 were supplied) is the standard A.O.P.

Landplane-transport squadrons are equipped with the Canadair North Star, of which 24 were built (this is essentially similar to the B.O.A.C. Argonaut); one V.I.P. Canadair C.5 (an improved version of the "Four," with Pratt and Whitney engines); Bristol Freighters; Fairchild Packets; Beechcraft Expediters; and Waco CG-4A gliders. "Utility" types include the famous de Havilland Canada Beaver and Otter, and for Arctic



Hawker Sea Fury F.B.11 fighter/bombers of the Royal Canadian Navy.

Serving Australia: Top left, Commonwealth Aircraft Avon-Sabre (the first prototype is seen before its first "official" flight); top right, de Havilland Vampire F.B.30s; lower left, English Electric Canberra B.20; lower right, "long-nosed" Avro Lincoln, developed for maritime reconnaissance.

(Above) Hawker Sea Fury F.B.11 aboard the Australian carrier H.M.A.S. "Sydney." (Upper right) A Firefly T.5 converted from a standard Mk 5 by the Fairey Aviation Co. of Australasia Pty., Ltd. (Below) One of the Bristol Sycamore Mk 50 helicopters supplied to the Royal Australian Navy.

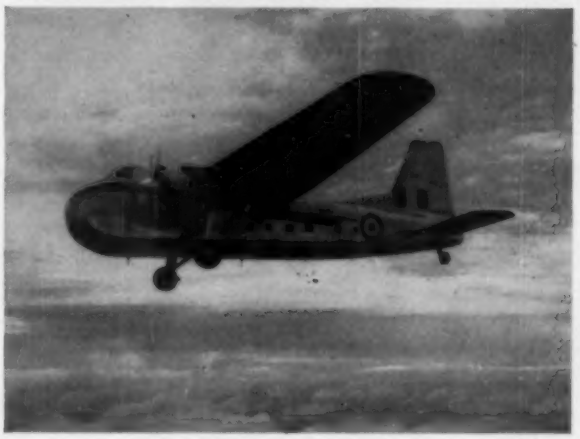
The Commonwealth Air Forces . . .

rescue six Piasecki H-21 twin-rotor helicopters (gross weight over 13,000 lb) are being acquired.

Standard piston-engined trainers are the North American Harvard (Cancar has built 550 of these machines for the R.C.A.F., the U.S.A.F. and NATO), and—for the R.C.A.F. Reserve—the de Havilland Canada Chipmunk, of which 158 were made in Canada. To these will soon be added 25 Cancar-built Beech Mentor T-34As, ordered by the R.C.A.F. "on a trial basis," and indicative of the scale of intentions for the future is the R.C.A.F. order for no fewer than 576 Canadair-built, Nene-powered Lockheed T-33AN Silver Stars.

Canadian Naval Aviation

A STRONG predilection for American flying equipment is evident in this Service today. Thus, the standard carrier-based fighter/bomber, the Hawker Sea Fury F.B. 11, is to be replaced by the American-built McDonnell F2H-4 Banshee, a twin-jet single-seater corresponding in performance to the Hawker Sea Hawk and having a similar armament, though with



Companion types serving with the R.N.Z.A.F.: (Left) A reconditioned Short Sunderland; (right) a Bristol Freighter.

(Above) A Handley Page Hastings and (below) D.H. Devons of the R.N.Z.A.F.

the added advantage of Hughes fire-control gear. But whereas the price of the Banshee is about £120,000, a Sea Hawk costs £50-60,000.

The principal role of Canadian Naval Aviation is anti-submarine work, and for this the Grumman S2F, powered by two Wright Cyclone piston engines, has been adopted in preference to Britain's Fairey Gannet, though the Gannet is obviously the more advanced aircraft in certain important respects. Again, whereas the S2F—which is to be built by de Havilland Canada—costs about £140,000, the price of the Gannet is more like £80,000. The most recent report from America states that the initial order for S2Fs (25 for the Royal Canadian Navy) will be increased to between 100 and 250 machines for NATO countries. Anti-submarine machines at present in service are Fairey Fireflies and reconditioned Grumman Avengers. Cancar Harvards and Bell and Sikorsky helicopters serve respectively for training and utility work.

The Light Fleet carrier H.M.C.S. *Magnificent* has been on loan to the R.C.N. since 1947 and will remain Canadian until about 1956; then, H.M.C.S. *Bonaventure* will be in commission. She is to be a light fleet carrier of the latest type, embodying the angled deck, steam catapult and every other device for increasing fighting efficiency. Her thick deck and heavy-duty arrester gear will permit the operation of the biggest and fastest aircraft now foreseen.

The Royal Australian Air Force

IN an interview accorded our Australian contemporary, *Aircraft*, earlier this year, Australia's retiring Chief of Air Staff, Air Marshal Sir Donald Hardman, said that to build the R.A.A.F. to adequate strength, without any spectacular development, would require an annual vote of £70,000,000 a year, whereas the vote then current was £55,000,000. "The Air Force, in this country," he

said, "for either defence or offence, is the only force worthwhile. It can be sent anywhere in the world to the point where it can do the most good in association with other Commonwealth forces, and be rapidly switched, if need be, to any other point. Australia is not likely to be attacked at any time in the near future, but if it was to be attacked the Air Force is the only force which can effectively prevent a hostile fleet from getting here, either by attacking it in harbour or by destroying it by bombing on its passage here." Sir Donald said it was frequently forgotten in Australia that there was no possibly hostile Pacific power with a fleet. Australia's main requirement, therefore, was an air task-force of fighters and bombers for strategic use, with home defence left in the hands of maritime and Citizen Air Force squadrons. Lockheed Neptune-equipped maritime squadrons, he said, could do any job that the Navy could do, including convoy—and do it better. That lesson had been well proven in joint exercises.

Sir Donald went on to say that it was a basic fact that to operate successfully even such a well equipped maritime weapon as the Neptune it was necessary to have air superiority; and the aircraft to give that superiority in a modern war was the strategic bomber. "In equipping the R.A.A.F. for the future," he said, "it would be a tragedy if Australia didn't keep a bomber element, for an air force without a bomber element isn't an air force. I hope that the R.A.A.F. will go on to medium bombers instead of the light bomber; by that I mean to one of the V-bombers—the Valiant or the Vulcan, or even an American type if that is preferred—as against the Canberra, whether Australia builds them herself or buys them."

In March this year Australia's Minister for Navy and Air spoke of a plan to equip the R.A.A.F. with 24 V-bombers "to guard Australia's northern danger points." To introduce these would cost, he suggested, between £30,000,000 and £35,000,000 including "the organization to fly them, spare parts and the necessary personnel."

Current R.A.A.F. bombers are the English Electric Canberra and Avro Lincoln. A special "long-nosed" development of the Lincoln for maritime reconnaissance duties is also in service, as are American-built Lockheed Neptunes.

Fighter squadrons—for the present equipped with Australian-built Nene-powered de Havilland Vampires—will soon be issued with the splendid Australian-developed Avon-Sabre. Transport aircraft include Douglas Dakotas, Vickers Vikings and Hunting Percival Princes, and for training there are D.H. Vampire Trainers and Tiger Moths, Airspeed Oxfords, Avro Ansons and Commonwealth Wirraways. The Tiger Moths will eventually be replaced by Australian-designed-and-built CA-22 Winjeels.

Australian Naval Aviation

IN succession to the famous carrier H.M.A.S. *Sydney* which, with its Fairey Fireflies and Hawker Sea Furies, made such a splendid name for the Royal Australian Navy in the Korean campaign, the carrier *Vengeance* was taken over last year and was to remain on loan for four years. Then the *Majestic* was to be transferred to Australia in her place.

In conformity with the policy of standardization on British equipment, the R.A.N. has ordered, at a cost of £3,200,000, forty Fairey Gannet anti-submarine aircraft, to be delivered in 1955, and has adopted the de Havilland Sea Venom as the standard all-weather fighter for carrier service. Of the Gannets, 37 will be used for operational duties and three for training.

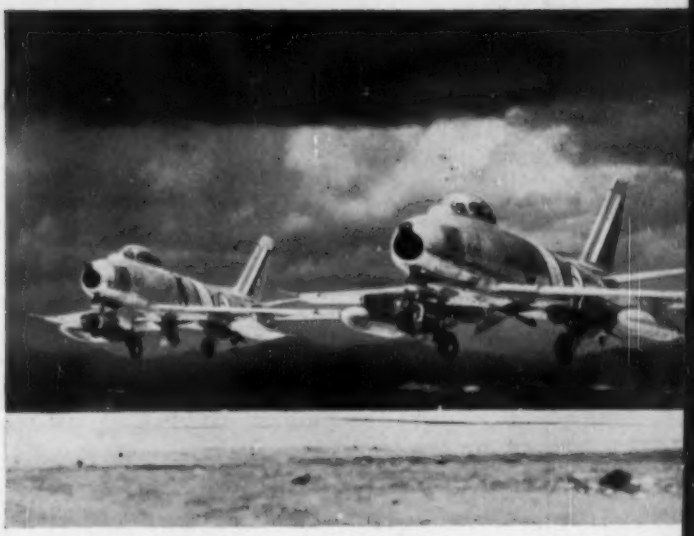
The standard helicopter is the Bristol Sycamore 50, employed for rescue, reconnaissance and liaison.

The Royal New Zealand Air Force

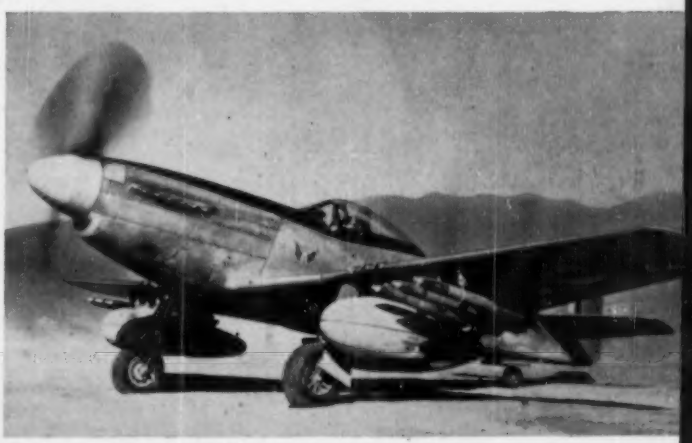
ALTHOUGH New Zealand has no multi-engined bombers, she has a number of fighter/bomber squadrons, wherein the de Havilland Vampire is standard equipment. Handley Page Hastings, Bristol Freighters and Douglas Dakotas are current transport types, and a flying-boat squadron, formerly armed with Catalinas, has lately been re-equipped with fully reconditioned and refitted Short Sunderlands. These are used for long-range reconnaissance and operate from Auckland and Fiji. In conjunction with—and on behalf of—the R.N.Z.A.F., the de Havilland company produced two flying classroom versions of the twin-engined Devon, one for instruction in radio communication and the other for training in radio navigation, and Devons are also used in the R.N.Z.A.F. for communications work. Standard instructional aircraft are Vampire Trainers, D.H. Tiger Moths, Airspeed Oxfords, Avro Ansons and North American Harvards.

The South African Air Force

WITH its thousands of miles of coastline, South Africa needs a long-range maritime-reconnaissance and patrol aircraft—a need which is being supplied by an order for Avro Shackleton M.R. 3s, secured in face of strong American competition. For similar duties Short Sunderland 5 flying boats have been in service for some years, and for medium bombing, as well as general reconnaissance, there are Lockheed Ventura twin-engined landplanes.



North American Sabres of the S.A.A.F. carrying bombs and drop tanks.



Predecessor of the Sabre in S.A.A.F. service: the North American Mustang.

The famous No. 2 (Cheetah) Fighter Squadron, after doing magnificent work on Australian-built Mustangs in Korea (some 10,000 sorties were flown in two years), re-equipped with North American Sabres, and by February last year the springbok markings were becoming familiar in "Mig Alley." The Sabres now supplement de Havilland Vampire 5 fighter/bombers and Spitfire 9s.

Transport aircraft include Douglas Dakotas and D.H. Devons, and for training there are Tiger Moths, Harvards and Vampire Trainers. Five special Auster 6s, with vertical and oblique camera positions and long range tanks, were supplied last year.

A Hunting Percival Pembroke C.1 of the Southern Rhodesia Air Force.

The Commonwealth Air Forces . . .

Hawker Furies of the R.P.A.F. operating on the North West Frontier.

Southern Rhodesia Air Force

AN article in *Flight* of July 2nd explained that the S.R.A.F. has reached a crucial stage in its existence, one of the reasons being that it is in process of re-equipping with new aircraft, better suited to its needs than the variety of ex-wartime types hitherto available. The new equipment includes de Havilland Vampires, Hunting Percival Provosts and Hunting Percival Pembroke C. 1s. Gradually the Spitfire 22s, Harvards, Ansons, Rapides and Tiger Moths will disappear.

The first duty of the S.R.A.F. is to train, and hold in readiness, two ground-attack squadrons. One of these is equipped with Vampire F.B. 9s and the second is working up on the Vampire Trainer. In an emergency these squadrons would expect to operate with the R.A.F., having been re-equipped with first-line fighter/bombers, probably Venoms. As a sideline the S.R.A.F. trains A.O.P. pilots for the Army, using Austers.

A Supermarine Attacker of the Royal Pakistan Air Force.

A Hindustan Aircraft HT-2 of the Indian Air Force.

The Royal Pakistan Air Force

THE Supermarine Attacker is the standard intercepter fighter of this air force, and fighter/bomber squadrons are equipped with piston-engined Hawker Furies. Handley Page Halifaxes serve as heavy bombers, and Bristol Freighters are employed for transport, in addition to Douglas Dakotas. Trainers include the perennial D.H. Tiger Moths and North American Harvards, Auster Aiglets and two-seat Hawker Fury Trainers. The Auster A.O.P. 5 is standard in its class. The general policy is to build up training establishments rather than to increase the number of squadrons, so that the R.P.A.F. is capable of quick expansion on demand.

(Above) A Boulton Paul Balliol T.2 of the Royal Ceylon Air Force. (Below) A Short Sealand of the Indian Navy.

The Royal Ceylon Air Force

A DOZEN de Havilland Chipmunks formed the initial training equipment of this force, which dates from 1949, and a small batch of Boulton Paul Balliols has subsequently been shipped out and assembled by Boulton Paul Aircraft Service. An unspecified quantity of de Havilland Vampire Trainers has also been despatched. It is intended eventually to form two jet-fighter squadrons.

The Indian Air Force and Navy

THE fighters and fighter/bombers available to the I.A.F. are Hawker Tempests, Supermarine Spitfires, de Havilland Vampires and Marcel Dassault Ouragans. A total of 71 Ouragans was ordered and all have been delivered by sea transport. Vampire Trainers serve for the instruction and familiarization of fighter pilots. For bombing and coastal patrol work there are Consolidated Vultee Liberators, and for transport, Dakotas and recently acquired Fairchild C-119Cs. Twenty-six of the Fairchilds are said to have been ordered—not, be it said, with M.D.A.P. funds. For training, in addition to the Vampires, there are D.H. Tiger Moths, North American Harvards and Percival Prentices. The Hindustan HT-2 basic trainer, designed and constructed by Hindustan Aircraft, Ltd., of Bangalore, has been adopted as the standard type in its category and is now in full production to this end.

On the occasion of the 21st anniversary celebrations of the I.A.F. on March 28th this year, the Indian Prime Minister, Mr. Nehru, arrived in a Sikorsky S-55.

Last November the tenth of a batch of Short Sealand amphibians was delivered to the Indian Navy. These were to be based at Cochin, on the western seaboard of Southern India.

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A Message from the Rt. Hon. Sir Eric Harrison, K.C.V.O., M.P., Australian Minister for Defence Production

STRENGTHENING of air power for the defence of Australia was announced recently as the firm policy of the Commonwealth Government for the future. The reasons are obvious from a glance at the map. Australia's 3,000,000 square miles of territory, spreading 2,000 miles from east to west and 2,000 miles from north to south, lie far from the United Kingdom and the United States of America, at the remote ends of supply lines stretching half-way around the world and ever vulnerable to attack in war-time.

Australia's 9,000,000 people occupy effectively only a portion of their vast island continent, with much of its 12,000 miles of coastline curving upward invitingly in a great arc towards the island stepping-stones of the East Indies and the restless spawning millions of Asia and Indonesia.

Australia's "empire" ranges many hundreds of miles farther north—almost to the equator—to embrace Papua and the trustee tropical territory of New Guinea and its outlying islands. Southward it stretches to that great slice of Antarctica over which Australia claims sovereignty on behalf of the British Commonwealth of Nations.

The only effective way for Australia to safeguard this outpost of Empire is to develop powerful and highly mobile task-forces that can be moved rapidly over great distances in emergency, to attack the forces of any potential enemy as far away as possible from the Australian coastline. Air power provides the answer—air power to defend the Australian mainland against invasion, air power to help the United Nations in policing the world.

Dismayed by the inability of the Royal Australian Air Force during the pre-war and early war years to obtain from British and American manufacturers operational aircraft of any kind, the Commonwealth has consistently sponsored local production of aircraft and aero engines of the most modern types. During the war several thousand aircraft and engines of a number of different types were delivered to the R.A.A.F. from local factories.

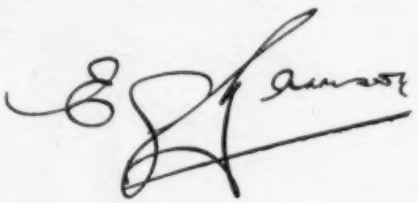
Since the 1939-45 war ended, the R.A.A.F. has been armed with fighters and bombers made in Australia. Trainer aircraft are also made in Australia for the R.A.A.F. and the R.A.N. Other types of aircraft required in smaller numbers are purchased in the United Kingdom or America.

Australia's rapidly expanding engineering industries are not yet capable, without completely unbalancing the national economy, of making and maintaining all the aircraft and engines and the countless items of aircraft equipment required by the R.A.A.F. and the R.A.N. either in peace or in war. Much has still to be drawn from the countries of the Old World, both in supplies and in technical assistance.

In establishing production of the English Electric Canberra medium bomber, the North American Sabre fighter (with improved performance, thanks to more powerful engines and armament) and the Rolls-Royce Avon engine, the Government has assured the fighting Services some at least of the front-rank operational aircraft they would require in emergency. Supplies of spare parts for the maintenance of those units are also assured. Consideration is even now being given to the selection of the more advanced types to follow the Canberra and the Sabre, evidence of the determination of the Government to arm the Australian Air Forces with the best equipment available.

What has been done by the Australian aircraft industry in less than 20 years amazes those who have never seen the country's modern well-equipped aircraft factories or the craftsmanship of the thousands who have accumulated years of manufacturing experience during and since the war.

What lies ahead of the industry can only be imagined. The Commonwealth Government is fully conscious of its responsibilities and will take the steps necessary to protect the rapidly increasing population; to maintain the British way of life in the South Seas—with the assistance of aircraft made in Australia.



THE AUSTRALIAN INDUSTRY—

PRINCIPAL MANUFACTURERS

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AUSTRALIA'S first large aircraft manufacturing concern, the Commonwealth Aircraft Corporation, owes its birth to a conference convened by the Commonwealth Government in 1935 to decide how best the country could arrange to provide for a proportion of its own military aircraft needs. Its formation by a group of large Australian industrial organizations took place in 1936, a year after the Conference recommended such a course. Among the names now associated with the concern are I.C.I. of Australia and New Zealand, the Orient Steam Navigation Co., Rolls-Royce, Ltd., and mining and metal companies including the Broken Hill Pty. Co.

The organization comprises a main airframe-producing plant at Fishermen's Bend, outside Melbourne; the engine factory alongside; and the subsidiary Government-owned engine factory at Lidcombe (p. 295) which C.A.C. operate as a Government annexe. In 1938 C.A.C. established its own aluminium foundry at Fishermen's Bend, and during the war years had turned out more than 2,200,000 lb of aluminium and magnesium castings to meet its own requirements and those of the Australian aircraft industry. In addition, a new foundry was set up at Highett, Victoria, for the production of magnesium castings, and by the end of the war this had taken over production of magnesium castings from Fishermen's Bend. Subsequently, however, another new foundry was brought into use at the main factory, and Highett handled the work for Merlin production at Lidcombe.

The activities of C.A.C. are under the control of the manager, Sir Laurence J. Wackett. The members of the board of directors are Messrs. L. Darling (chairman); Essington Lewis (chairman of the wartime Aircraft Advisory Committee); K. G. Begg; M. L. Baillieu; Lt-Gen. Sir Leslie Morshead and Sir Alexander Stewart. The secretary is Mr. A. G. Brown.

Aircraft Division

Work on a two-seat aircraft not unlike the Harvard and based on a North American design, started at Fishermen's Bend as soon as the factory was equipped and staffed, and the first Wirraway as it was called, fitted with an American Pratt and Whitney Wasp engine, flew on March 27th 1939. At the outbreak of war, when six Wirraways had been delivered to the R.A.A.F., production was at once stepped up and within a year 100 had been delivered and by June 1942, the order for 620 had been completed. An additional order for this trainer/general-purpose aircraft brought the total to 739 by February, 1946.

THE AUSTRALIAN INDUSTRY . . .

During this period C.A.C. had not, however, confined their efforts to this one aircraft, for a requirement arose for a less advanced trainer and in addition thoughts were turned towards a relatively simple, quickly producible fighter. The former, known as the Wackett Trainer and fitted with a 7-cylinder Warner Scarab, was superficially similar to the Wirraway. Of these 200 were delivered in a 12-month period up to April, 1942. During the war years, some 10,000 pilots received training on Australian-built aircraft.

The intercepter, designed to confront the Japanese in their southward island-jumping advance, was named the Boomerang. It, too, was a low-wing radial (1,200 h.p. Twin Wasp) type and deliveries began in August 1942. By 1945 the order for 250 had been completed. At the wartime peak Commonwealth employed 10,000 people.

As with every large aircraft-producing organization, continuity was essential for C.A.C., and when the termination of Boomerang production was foreseen a new type was selected. The satisfactory association—maintained to this day—with North American Aviation and the excellence of the Anglo/American Mustang itself led to the selection of that design as the next to which C.A.C. should turn. The Rolls-Royce Merlin engines were supplied from America (where they were being built under licence by Packard), as were components for assembly of the first aircraft off the line. Number one Australian-built Mustang was completed in May 1945, and after the Japanese surrender, 59 were delivered at a leisurely rate by early 1946. Some of these aircraft later saw service over Korea.

During the war years a great deal of repair and modification work was also undertaken in the C.A.C. factories.

It is not surprising that with the concept of the greatest possible degree of self-sufficiency in first-line military aircraft firmly established in Australia, C.A.C. should next turn its thoughts to a powerful new fighter, and during 1949 and 1950 £A5m. was authorized for a design study, development and the building of a prototype. This machine was described as a two-seat attack fighter with a pair of Rolls-Royce Tay turbojets. Swept wings and tail, and radar in the nose were also planned. This ambitious project was abandoned as a result of a change of policy—a decision to be regretted in some ways—and sensibly enough after its Mustang experience, C.A.C. next turned its attention to the latest North American design—perhaps that company's most valuable contribution to defence—the F-86 Sabre.

Admittedly, in keeping with Australia's treasured ties with the mother country, contemporary British fighter designs had been studied before the Sabre was selected. This actually wasted some valuable time and continuity was interrupted, but nothing in England—including especially the P.1081—was at that time considered to be in a state of development which made building under licence a reasonable proposition. However, Australia was able to select a late mark of Sabre, to modify it substantially and to provide it with a Rolls-Royce Avon turbojet. The result is almost certainly the most formidable of the numerous F-86 variants and it will be adequate for first-line combat anywhere in the world for two or three years to come.

This Australian version of the Sabre is the company's current concern, and the work was examined by *Flight* during a visit earlier this year. At that time the first Avon prototype had been flying for some time (since August 3rd 1953) but this was not entirely Australian built. In 90 flights no aerodynamic snags had been met or modifications called for. The first production CA-27 Sabre made an initial 35-minute flight on July 13th, 1954. This is, of course, by far the most ambitious project so far undertaken by C.A.C., and the cost of each aircraft has been estimated as £A250,000. The initial order is for 72 Sabres.

Australian Sabres with Avon RA.7s have reached supersonic speeds, have a climb rate almost twice as great as those variants used in Korea, a ceiling of about 55,000ft, have more formidable firepower (2 × 30 mm guns) and a radius of action exceeding 500 miles with fuel for 15 minutes combat in addition. Provision is made for carriage of air-to-air missiles. Other details are given on page 277.

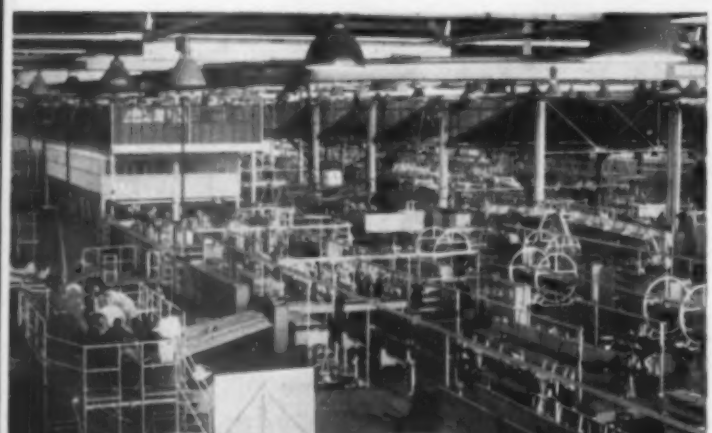
Production plans for Sabres are based on an output of one aircraft per week, including its engine and spares; by bringing in sub-contractors this could easily be doubled. At present the tapered skins for the wings are imported, as were the production jigs. The first 20 Avons to be installed will be Rolls-Royce-built.

All jet aircraft are now transported to the Government's new airfield at Avalon for final assembly and test flying. The old airfield beside the two plants at Fishermen's Bend is retained for piston-engine types only.

At the factory may also be seen the start of Winjeel production. The Winjeel is an all-Australian basic trainer designed to much the same specification as the Provost. Two prototypes have been built and flown, and an order has been placed for 62 of them. The first 30 will have Wasp Juniors until C.A.C.'s own Cicada radial (p. 297) is ready. The fuselage will be made by C.A.C., but other main components will be sub-contracted—de Havillands are making the wing.

The decision must soon be taken as to what aircraft is to follow the Sabre. The F-100 Super Sabre is, of course, in mind as one likely possibility, but there is some doubt as to whether a single-seat single-engined type is the right sort of fighter to send out over the Timor Sea for 500 or more miles. That the factory is attuned to North American methods and American standards will obviously influence this decision.

Avon-Sabre production gets under way in the Commonwealth factory at Fishermen's Bend, on the outskirts of Melbourne.



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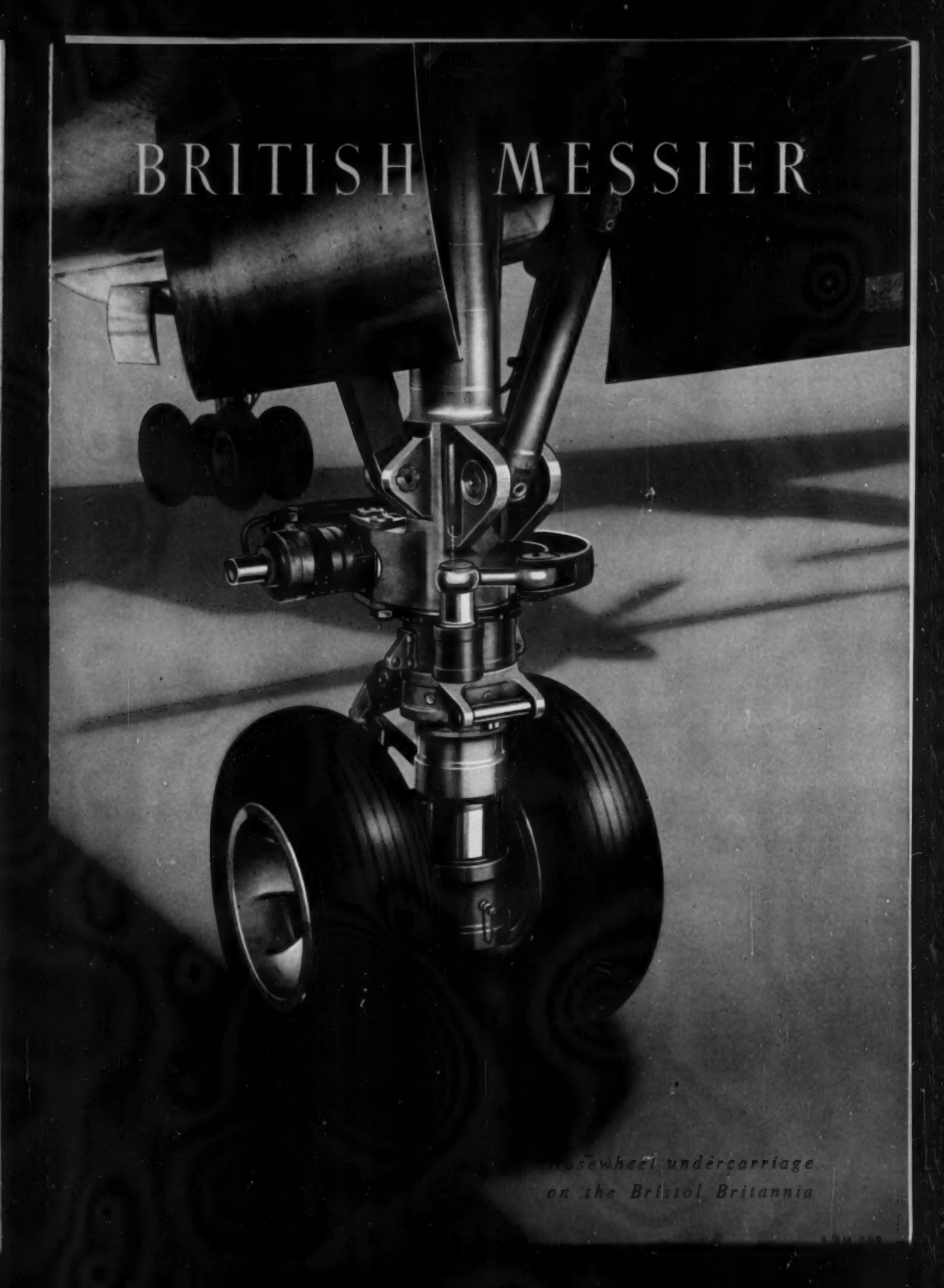
JUST as the name of de Havilland and the parent company have been linked with so many pioneering exploits and aviation achievements in England from the very early days, so in Australia de Havilland is a name almost synonymous with flying. As long as most pilots can remember, de Havilland aircraft have been flying in and to Australia, and, for example, in 1931 the first air mail to England was flown by Qantas in a D.H.61. Soon afterwards the Flying Doctor service came into being. By that time the Australian branch—the first to be opened overseas—was already five years old, having officially come into being on March 7th, 1927, following a survey the previous year by Major Hereward de Havilland.

The purpose was at first to provide a D.H. sales and service organization, but this very soon developed an assembly section, and, to trace very briefly these early years, a few Cirrus Moths were first put together, then at the end of 1928 Gipsy Moths—thirty of them—were assembled for the R.A.A.F. During this period the works was no more than a 6,000 sq ft galvanized warehouse on the outskirts of Melbourne, but the staff reached a total of 215. Aircraft were towed with wings folded the seven miles to Essendon airfield for testing.

In 1930 a move was made to Sydney and a hangar was occupied at Mascot. Manufacture proper started in 1932, wings being the main product; other major components were still shipped out from home. Servicing work also increased considerably, and a training scheme was inaugurated for the works. The aircraft of the middle-thirties were the Fox Moth, Dragon and Rapide, in addition to earlier Moths.

At the time, 1938, when the large Government-sponsored C.A.C. was preparing to get into production with its Wirraway advanced trainer, a proposal was made to the Australian Government that a new factory be set up to produce v.p. airscrews. The following year an order was received for 100 constant-speed airscrews, and the propeller factory was built at Alexandria, near Sydney. It was most fortunate timing, and this Australian propeller division went on to do exceptionally valuable work in the war years—repairing, servicing and, more important still, manu-



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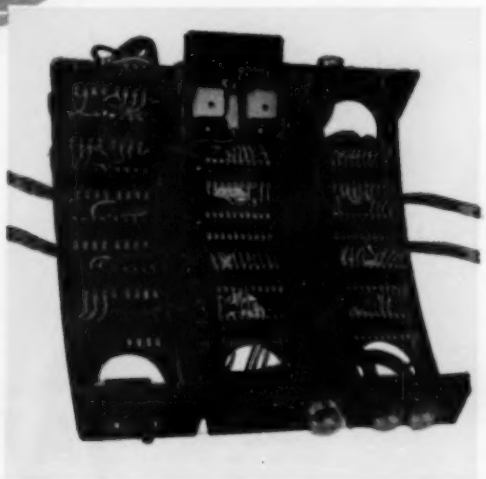

Electrical Supply Panel—Hawker "Hunter". A typical example of preformed wiring employing Plessey components. (Photographed by courtesy: Hawker Aircraft Ltd.)

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De Havilland's factory and flight shed at Bankstown Airport, outside Sydney, N.S.W.

THE AUSTRALIAN INDUSTRY...

facturing more than 2,000 v.p. airscrews, mainly of Hamilton type. Only ball bearings and the virgin ingots were imported.

Just before the war the aircraft company had reached the stage of building complete airframes except for certain metal fittings, but engines were still imported. With the coming of war the R.A.A.F. placed a large order for Tiger Moths, and the first of 350 was delivered nine months later. For the first time also the Gipsy engine was manufactured under licence in Australia, the work being undertaken by General Motors-Holden's, Ltd. Later orders for Australia, the U.K. and the Dutch Indies brought the total of aircraft to 1,070, almost all of which were delivered by 1942.

Few people know, incidentally, that a prototype and seven pre-production troop-carrying gliders were built in 1942-3 by D.H. Australia.

At the modern Bankstown factory outside Sydney, which had been designed as an assembly hall and was then newly opened, Mosquito production was put in hand by de Havilland Australia in 1942. From the receipt of drawings only thirteen months elapsed before the first delivery was made of an order for 370. By February 1946 158 had been delivered and a total of 212 by the time the production of these aircraft was brought to a close in 1948 (after having been much slowed down at the end of the war). More than 1,200 aircraft were built by D.H. Australia towards the war effort.

Mosquitos were followed by Nene-Vampire 30s, Australia's first jets, and to these have been added an order for Goblin-powered Vampire Trainers upon which the company is now engaged.

Of the 80 Vampire 30s and their Rolls-Royce Nene turbojets almost all components have been built in Australia. The line for the Trainers now in hand was started with the aid of some two dozen fuselages sent from home, and about 25 complete aircraft have been delivered against the R.A.A.F. order for 36. The R.A.N. have ordered five which are next to be delivered. A full quota of production jigs was seen by our representative during his visit; after the order has been fulfilled they will continue to be used for repairs and major overhauls. Wings for the new Commonwealth Trainer the CA-22, Winjeel, were also being put in hand.

In addition to the military work and a great deal of repair and servicing, a completely original design was drawn up as a Rapide replacement and a small number of the aircraft, the D.H.A.3 Drover, built. This machine is a simple and rugged 6/8-passenger tri-motor transport. The engines are Gipsy Moth 10s, now fitted with fixed-pitch metal airscrews. Trouble with v.p. airscrews on the first machines to go into airline service handicapped the Drover. Their removal in favour of simple fixed-pitch blades has brought about a reduction in performance which, however, is in part offset with the aid of a new double-slotted flap design.

About 1,000 people are employed of whom 600 are directly on production—which includes, still, a few wooden parts for the pre-war D.H. types.

Of the overhaul side of the work at Bankstown we may mention modern facilities for D.H. turbojets—Goblin and Ghosts, the latter capacity originally planned with generous spares provisioning in preparation for Comet 1s. An eye is also kept on the possible needs—engine and airframe—of the Butler Herons (reported to be very popular with passengers). A few Drovers are still being modified with the new flap system, and our pilot was able to fly VH-AHY, so equipped, and also to examine a "Flying Doctor" machine.

In a separate department the Fescol (metal build-up) reclamation process is carried out under licence, and a great variety of aircraft engine and other work finds its way there.

A five-year apprentice scheme is operated which if a man shows sufficient promise would enable him to attend a University course in England.

The company's attractive head office building is also located at Bankstown. The managing director is A. Murray-Jones, who in war-time as general manager was responsible for all production. Also on the board are J. J. Byrne, D. H. McLachlan and R. J. Vicars. A great name in Australian aviation also finds a second-generation connection with the company, R. Kingsford-Smith being sales manager.

Assembly of Nene-Vampires by de Havilland of Australia.

GOVERNMENT AIRCRAFT FACTORIES

THE Australian Government, through the Department of Defence Production, which in turn controls the Division of Aircraft Production, is more directly concerned with the work of the Government Aircraft Factories than are any of the other Dominion Governments with their aircraft-manufacturing organizations. During the war the other large Australian companies, of course, came into the Government fold, and it should be noted that the annexes managed by C.A.C. at Lidcombe and D.H. at Alexandria, both of which are described under the headings of those two companies, are, in fact, Government factories.

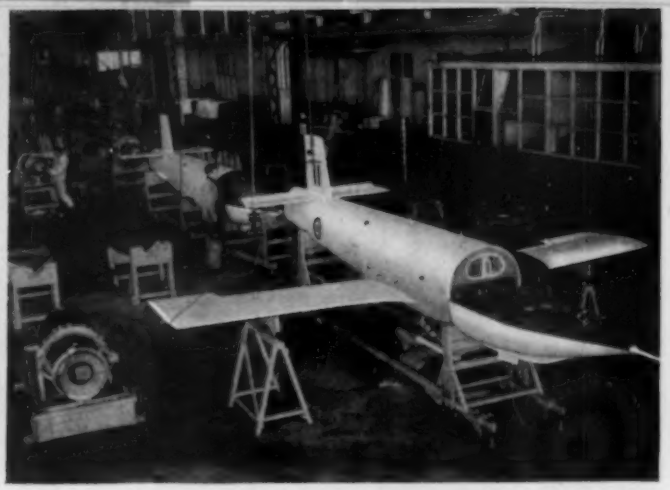
For a description of the background and the formation of the Government Factories and also of their wartime activities we can do no better than pass on the lucid summary given to us by Mr. Hanford Stevens, assistant secretary (Aircraft Production).

Manufacture in Australia of aircraft required by the Department of Air for equipping the Royal Australian Air Force and by the Department of the Navy for the Naval aircraft activities is arranged by the Division of Aircraft Production of the Department of Defence Production, one of the "Defence Group" of Departments of the Commonwealth Government.

The Division is responsible also for the supply of maintenance spare parts to the extent to which they can be obtained against orders placed in Australia and for the repair and overhaul of aircraft, aero engines and ancillary equipment operated by the R.A.A.F. and the R.A.N. where not undertaken in Service establishments.

At the end of 1938 there visited Australia the United Kingdom Air Mission, whose purpose was to investigate the possibilities of producing operational aircraft in Australia. After surveying the Australian industrial background, the Mission reported in March, 1939, that an organization should be set up on the basis outlined for the production in Australia of Bristol Beaufort bomber aircraft.

The report was approved by the British and Australian Governments on the basis that an initial order would be placed for 180 Beaufort aircraft of standard design with spares, production and costs to be shared equally between the two Governments. To give effect to this decision, there was established in July,



The Australian Government Factory is located beside that of Commonwealth at Fishermen's Bend, Melbourne, Victoria. Above are seen Canberra nose sections (left) and Mk 2 Jindiviks (right) in production there. The turbojets seen with the Jindiviks are A.S. Vipers. (Below) Canberras in the final assembly hangar at Avalon (see picture at foot of page).

THE AUSTRALIAN INDUSTRY . . .

1939, an Aircraft Construction Branch of the Department of Supply and Development.

The "Beaufort scheme" was based on the utilization of the existing railway organization and of floor space in the main railway workshops in several States of the Commonwealth and the erection of final assembly plants in Melbourne and Sydney.

Initial arrangements only had been put in hand when the 1939-45 war began. Under the stimulus of war conditions the manufacturing and assembly facilities originally planned were greatly extended. When the Japanese entered the war in 1941, about the time the first Australian Beaufort aircraft were being delivered, the decision was reached, with the agreement of the British Government, that all such aircraft manufactured would be retained in Australia for use by the R.A.A.F.

During the war years, this Government Aircraft Factory delivered 700 Beauforts and 329 Beaufighters and was well advanced with the establishment of facilities for the production of Avro Lincoln bombers when the war ended. Beaufort/Beaufighter production was maintained at the average "pegged" rate of 30 per month over a considerable period.

These wartime facilities employed approximately 10,000 men and women at the peak of activity. With the cessation of war, the scale of activities was rapidly reduced. Beaufighter production continued to the completion of aircraft then at an advanced stage of production and reached a total of 364.

The factory activities were concentrated into the major workshops at Fishermen's Bend, Victoria, with sheet metal assemblies at a subsidiary plant at the Essendon airport, Victoria. Token production only was maintained at the State Railway workshops in New South Wales and South Australia.

Lincoln production was restricted to not more than one aircraft per month to maintain nucleus capacity and essential manufacturing skills and techniques for preparedness reasons.

The Lincoln production programme was completed during 1953 at 73 aircraft delivered, including a number of aircraft incorporating a major modification—extension of the front fuselage by 6ft—to convert the aircraft into a more effective long-range anti-submarine type.

Early in 1950, there was entrusted to the Government Aircraft Factory the production of English Electric Canberras and this project has since been advanced to the stage where delivery of aircraft at the normal monthly rate necessary to meet the peace-time needs of the R.A.A.F. has been established. The first Australian Canberra made its initial flight during May 1953. The current programme is for 48 aircraft.

Jindivik target and research aircraft—Mks 1 and 2—with Armstrong Siddeley Viper turbojets, are also being manufactured. The early development of this machine was carried out with the piloted Pika prototypes which flew in 1950 (see page 279). Important units of the Jindivik are supplied from England; for example, the radio by G.E.C. of Coventry, the auto-pilot by Elliott Brothers of London, and the telemetering equipment by McMichael Radio of Slough. Recently it was announced that a substantial order for Jindiviks had also been placed by the U.K. Ministry of Supply.

Today, the Department of Defence Production is directed by the Minister, Sir Eric Harrison, whose message heads this section. The officers of the department controlling the Division of Aircraft Production are the secretary, who is the permanent head, H. P. Breen; the controller-general of Munitions Supply, R. H. Doyle; and the assistant secretary (Aircraft Production), J. Hanford Stevens. At the Government Aircraft Factories the general manager is M. B. Woodfull, and the manager at Fisher-

The Australian Government's new airfield at Avalon, Geelong, Victoria, has large hangars and fine new runways. It is used as the flight test field and final assembly division for jet aircraft.

men's Bend is N. W. Hodgson. The Maintenance Branch is headed by M. A. W. Forestier, while at the new airfield and establishment at Avalon the acting area manager is J. C. Miles.

The central establishment of the Government Aircraft Factory is the Main Assembly Plant at Fishermen's Bend, Melbourne. Supplementary establishments comprise a workshop at Essendon Aerodrome, Melbourne, the flight-test field, with final assembly and flight-shed facilities at Avalon; and major sub-contractors.

At Fishermen's Bend are the administrative, design and planning offices, machine shop, tool room and experimental workshops, as well as the main assembly plant. Here is carried out the manufacture and assembly of Canberras and Jindiviks. Included among the departments is one for plastic forming and another in which both Redux and Araldite techniques are employed. Assembly occupies 177,000 sq ft of floor area; the machine shop 28,000 sq ft; and another 23,000 sq ft are devoted to experimental work.

At the Essendon factory are manufactured some details and sub-assemblies. Major sub-contractors and their products are as follows:—Chrysler Australia, Ltd., Finsbury, S. Australia (manufacture of pressed parts and sub-assemblies); South Australian Railways, Islington, S. Australia (manufacture of wing spars); New South Wales Railways, Chullora, N.S.W. (manufacture of sundry details and sub-assemblies).

The Government Factories have a considerable repair, modification and spares commitment for the R.A.A.F., and the section devoted to this work occupies 37,000 sq ft. In addition there are instrument and radio rooms, separate maintenance workshops and a central stores which itself covers 84,000 sq ft.

The factories and airfields (excluding sub-contractors) now employ 3,000 people and the maintenance branch, 670.

Plans for future activities at the Government Factory are almost entirely dependent upon the determination of the types and numbers of aircraft likely to be required by the R.A.A.F. Under peacetime production rates the current Canberra project will continue until 1957. There is already talk of new types of Jindiviks with greater performance, and production of this type of pilotless aircraft is likely to continue for several years.

COMMONWEALTH ENGINE DIVISION and ANNEXE

THE power requirements of the Commonwealth Aircraft Corporation airframe division have largely dictated the choice of the units to be produced in the two Commonwealth engine factories. The background of the main factory at Fishermen's Bend, near Melbourne, and of the annexe at Lidcombe, Sydney, was referred to earlier.

The first engine to be built was the Pratt and Whitney Wasp for which a licence was obtained from the American company. These units were required for the Wirraway trainer and 680 were built in all. While the Wasps were still in production urgent wartime requirements resulted in the establishment of Twin Wasp production lines, and between the years 1941 and 1945 870 of these two-row radials were turned out. These engines were required mainly for Beauforts but also for Boomerang intercepters. It had been intended that the Beauforts should have Bristol Taurus engines, but the difficulty of wartime deliveries made it necessary to redesign the aircraft to take the Twin Wasp.

It was between January 1939, and September 1943, that the P. and W. Wasp engines were completed at the Fishermen's Bend plant. The annexe factory at Lidcombe was engaged on the production of the Twin Wasps.

On the termination of its Twin Wasp contract the Lidcombe factory was next tooled up for Merlins required for Lancasters, Mustangs and Mosquitos—first deliveries to be made towards the end of 1946—and it is these units, together with spares, and overhauls for Griffon, Centaurus and P. and W. Twin Wasp 1830s which today occupy the factory. The latest type of Merlin is the 102 for R.A.A.F. Lincolns. The first Commonwealth Merlin was delivered in July 1946. The production programme has been much curtailed since the wartime peak effort of 40 units per month.

With the re-equipment of Lidcombe for Merlins in 1945-6 the whole of the production of Twin Wasp spares and the overhaul contracts for these engines was for a time transferred to Fishermen's Bend.

About 1,100 people are now employed at Lidcombe on a normal 40-hour week (this compares with a wartime peak of 3,000 working on a two-shift basis). The factory goes in for very little sub-contracting, and makes its own A.G.S. parts. Tooling, which has often constituted something of a bottleneck, is also handled, and not only the factory's own needs are satisfied but also quite a lot of work is done for the Fishermen's Bend division in connection with Nene and Avon production and for General Motors Holdens, Ltd. (Incidentally, it was the Holden interest in C.A.C. of nominally 10 per cent which was later bought out by Rolls-Royce.)

The Lidcombe factory is largely equipped with machines supplied under the wartime American Lease-Lend agreement. To this has been added some machinery to suit Merlin production, and some fixtures became available from the Rolls-Royce factory at Crewe. The majority of castings for the Merlins came from C.A.C.'s own foundries, and only the Merlin crankshaft forgings were imported—from Glasgow. Previously Pratt and Whitney radials had also been about 95 per cent Australian produced; carburettors and bearings were the only bought-out parts at the end of the war. The Pratt and Whitney spares again being produced at Lidcombe are not only for the Australian Government but also for airline operators such as Cathay Pacific who are thus able to obtain their parts without the expenditure of dollars.

Of the engines overhauled by C.A.C. one in five is usually stripped and re-run after an initial four hours of acceptance running on the beds. Merlins and Twin Wasps are exceptions in having only one in ten stripped. One dynamometer test bed was brought out from Rolls-Royce's Hillingdon, Glasgow, plant and this doubles for Merlin and for Meteors which are the Centurion tank version of the Merlin for which an Army contract has recently been received.

Lidcombe runs a technical school with an intake of about 25 machinists per annum. The course is for three years and includes 1,000 hours of schooling in addition to factory work.

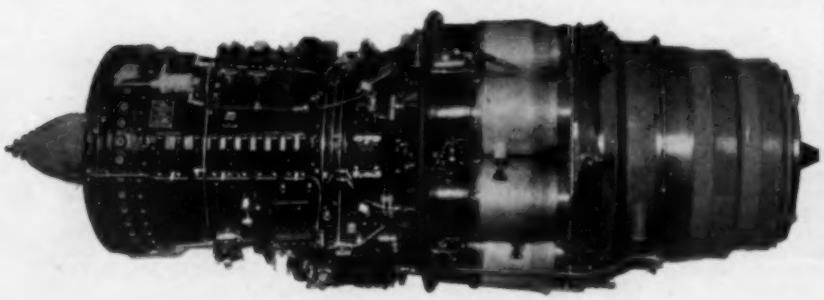
Since the war the Fishermen's Bend engine factory has branched out, and it is now concerned with Rolls-Royce turbojets and with a new 450 h.p. seven-cylinder Australian radial engine known as the Cicada which has been designed and developed by C.A.C. engineers. The Cicada is required for the Winjeel trainer. The first Cicada engine was submitted for test in March 1953, and production is now at the planning stage.

The first Rolls-Royce turbojet to be produced was the Nene, which was ordered for the Australian version of the Vampire built by the de Havilland Pty. There had been plans to follow this with the Tay, but instead, as a result of changes on the aircraft side, the Rolls-Royce Avon was selected.

One of the visits which most impressed our representative while in Australia was that paid to the C.A.C. Avon factory, now fully tooled up and started on production. This would show up well even beside the finest plants of a similar nature in America or England.

Earlier this year Avon R.A.3s were being delivered for Australian-built Canberras, but plans were already in hand for a change-over to R.A.7s, known as the Mk 20 in Australia as fitted in the Sabre, and as the Mk 109 with additional de-icing equipment, in the Canberra. The Mk 20s, unlike the home-built product, have constant-taper Solar jet pipes. This Sabre unit also has a 200 h.p. gearbox take-off with spiral-bevel-gear drives.

A Commonwealth Avon R.A.3. These units and also R.A.7s are in production under licence from Rolls-Royce.



At the time of our visit Avon and Nene parts were still flowing side by side. Some 22 complete Avons had been turned out, and on the completion by now of 114 Nenes only spares will be in the making for this unit. All main Avon components are to be made by C.A.C., and the factory is more self-sufficient in regard to these units than it was for the Nenes.

Of the four test beds used by C.A.C. at Fishermen's Bend, two are for piston engines and two for turbojets—one each for Nenes and Avons of all marks.

INDIA

Production of HT-2 Cirrus-Major-powered trainers at the Bangalore factory of H.A.L.

HINDUSTAN AIRCRAFT, LTD.

CHRISTMAS EVE, 1940, saw the foundation of Hindustan Aircraft, Ltd., and the laying of the foundation stone for its factory at Bangalore, Mysore State. The founder of the company was Seth Walchand Hirachand, and capital for its formation was provided by the Government of Mysore. The intention, like that in Canada and Australia, was to make a start towards independence in regard to the country's aircraft requirements. H.A.L. remains the only manufacturer of aircraft in India and has made very creditable progress in its fourteen years.

Briefly, the course of the company's first ten years' activities were as follows: after its foundation, the construction and organization was entrusted to Mr. W. D. Pawley. During the first year, two of six directors were nominated by the Mysore Government; the Indian Government became a one-third shareholder, the capital being increased from 40 to 75 lakhs (£562,500); Air Marshal Sir John Higgins became the resident director and the first aircraft, known as the Harlow PC-5, was assembled under American licence and flown in August 1941.

Almost exactly a year later, on July 31st, the first Curtiss P-36 Hawk had been assembled and was test flown, and a month later the first Indian-built glider was tested. During this period, too, an American order was placed for fuel tanks, and to meet other contracts for maintenance of a variety of military aircraft a large expansion of the premises took place.

In 1943 the management of the factory was taken over by the U.S. Army and a three-shift system introduced. The numbers employed reached 15,000, and the engine department, which was then separated, achieved an output of 300 units in the month. It was in this year that the Government of India created a Directorate General of Aircraft Maintenance and Repairs with Sir James Pitkeathly as the head.

In August 1945 the U.S. Army handed back the management of the factory to the Indian Government, and with the cessation of war a very difficult period was experienced, in common with other aircraft companies the world over. Difficulties were overcome, and, following the visit of a U.K. technical mission in March 1946, it was decided that the company should be developed for aircraft manufacture but that in the meantime the building of railway coaches should be undertaken as a subsidiary activity.

There was considerable internal reorganization in 1947; a board of management was appointed, together with the first chairman, C. W. Casse; and the design department was strengthened. H.A.L. also became the authorized Douglas service agent in India.

In 1948 design work was progressed on two trainer aircraft, the HT-2 and the HT-10, and at the same time overhaul work on American B-24s and plans for Prentice construction were in hand.

The first Indian-built Percival Prentice was test-flown in mid-1949, and in 1950 a new chairman, H. M. Patel, secretary to the Ministry of Defence in the Indian Government took over. During this time the railway and road coach activities were flourishing and a new order was received. Since that time the HT-2 has been put into production, a licence to manufacture Vampire trainers acquired, and that work put in hand. There was also an extension of the overhaul work on Liberators, Dakotas and Doves.

H.A.L. is now controlled by a board of directors comprising the recently appointed chairman M. K. Vellodi, secretary to the Defence Ministry; J. R. D. Tata and E. V. Ganapathy Iyer. The board of management has J. M. Shrinagesh as chairman. Dr. V. M. Ghatage is chief designer.

In addition to the Bangalore factory with its production, overhaul, engine and coach divisions, there is a branch servicing organization at Barrackpore, near Calcutta.

The present payroll is about 8,000, and the factory space amounts to 1¼m sq ft. The Prentice trainer programme was successfully completed in 1953. HT-2s—the Indian designed and built all-metal Cirrus-Major-powered basic trainers—are to be supplied to Indian civil flying clubs as well as to the Air Force. The manufacture of Vampires is in hand, and work is proceeding on the prototype of an advanced fighter-trainer. This, the HT-10, is a side-by-side design with Twin Wasp engine. Figures appear in the table on p. 284. H.A.L. are members of the S.B.A.C. and have been accorded C.A.A. approval.

NEW ZEALAND

FEW nations of similar size have taken a more active interest in aviation than New Zealand. A recent enterprising example was the London to Christchurch Air Race. That no aircraft are actually designed or manufactured in the islands is due mainly to the high cost of maintaining productive capacity and of tooling-up, which in turn results in a high selling price for aircraft for which the home demand would of necessity be small. Other countries understand, and some have experience of, this situation. As a result, aircraft have to be imported.

Today two companies described below are specially concerned with aircraft assembly as well as with major repairs and overhauls. There are in addition others engaged in operating and servicing, representation and the sales of materials and equipment. In particular, British Aircraft, Ltd., of Embassy Theatre Building, Wellington, represent several British manufacturers.

The de Havilland Aircraft Co. of New Zealand

ALTHOUGH The de Havilland Aircraft Company of New Zealand does not at present manufacture aircraft, their capacity to do so was well demonstrated during the war when 345 Tiger Moths were turned out for the R.N.Z.A.F. Concurrently Oxfords and other aircraft were overhauled. Since that time also Fox Moths, Chipmunks and Devons have been assembled.

Today the work of the factory at Rongotai Aerodrome, Wellington, is centred upon giving good service to all users of D.H. products—aircraft, engines and airscrews. The available facilities are also used for similar work on other types of aircraft.

At Palmerston North, D.H. operate an overhaul shop for Goblin gas turbines for the R.N.Z.A.F.

The Rongotai premises occupy 28,800 sq ft and 70 people are employed. No major changes in the present organization for sales or service are foreseen for the near future. The general manager is J. A. Kerr; D. W. Gendall is secretary, and R. W. Jamieson is assistant general manager.

James Aviation, Ltd.

THIS company is responsible for the assembly of Fletcher FU-24 top-dressing aircraft, 100 of which have been ordered for New Zealand use. Designed and manufactured by the Fletcher Aircraft Corporation of Pasadena, California, this machine is specifically intended for New Zealand flying conditions, and in addition meets American crop-dusting requirements. The order for the aircraft was placed by the Cable-Price Corporation, and their assembly will take place at the James Aviation Rukuhia workshops.

In addition to this work, the firm specializes on the operating side in agricultural and charter flying, and has an extensive aircraft repair organization. The managing director is Mr. O. G. James. Address: Hamilton and Rotorua, N.Z.

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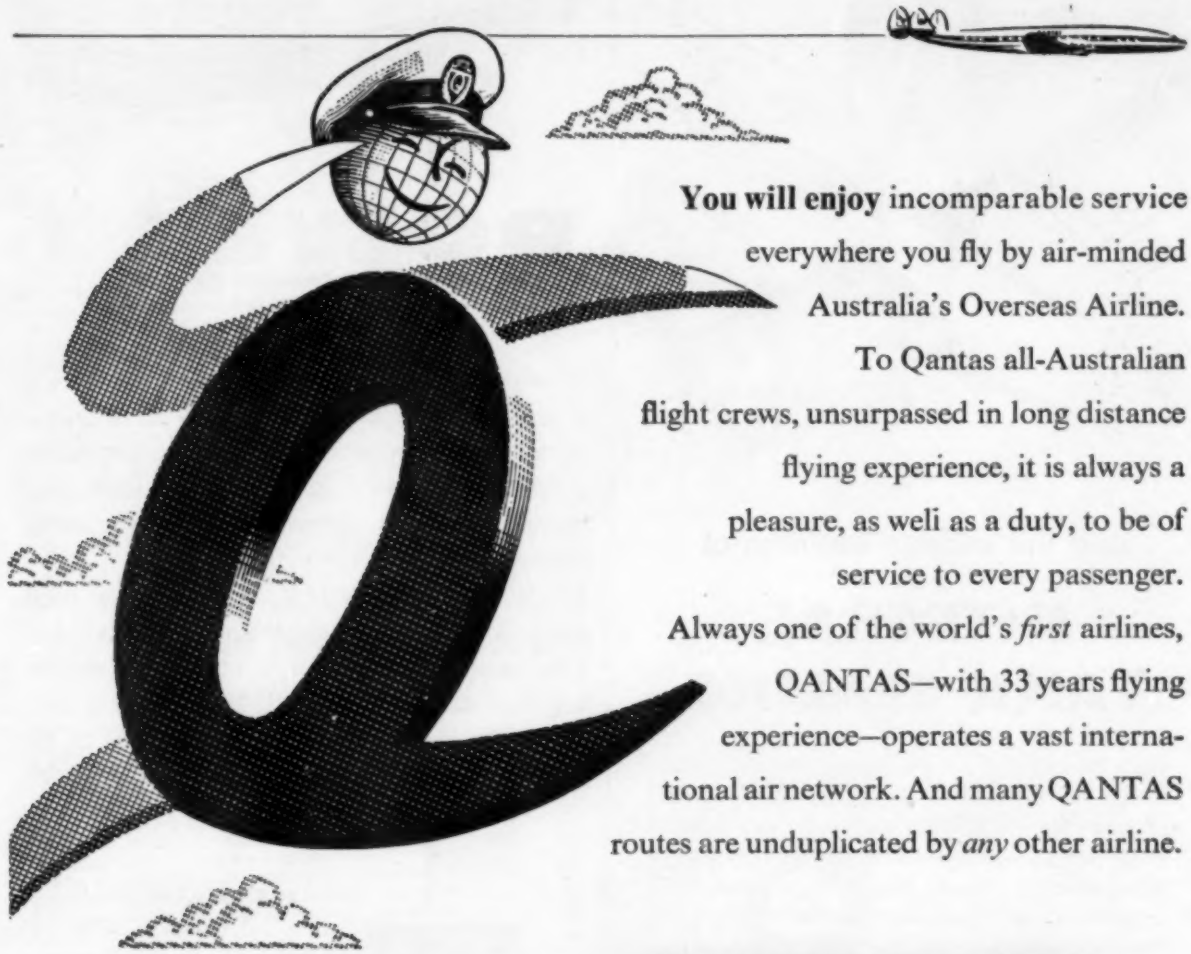

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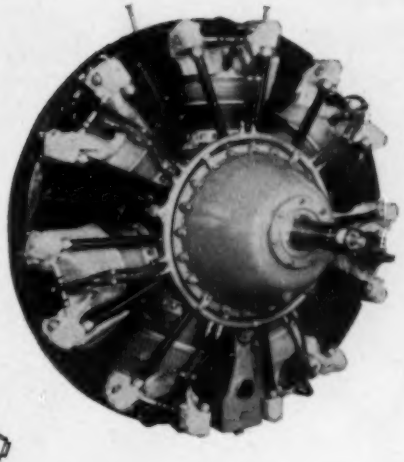
COMMONWEALTH ENGINES—1954

ALL AIRCRAFT engines produced in the Commonwealth countries, including those built under licence, have been referred to under the names of the companies concerned with them. There is, however, one piston engine—the Cicada—which is wholly the work of the Australian Commonwealth Aircraft Corporation, and one turbojet—the Orenda—which has been designed and developed by Avro Canada. These two engines are singled out on this page for special reference.

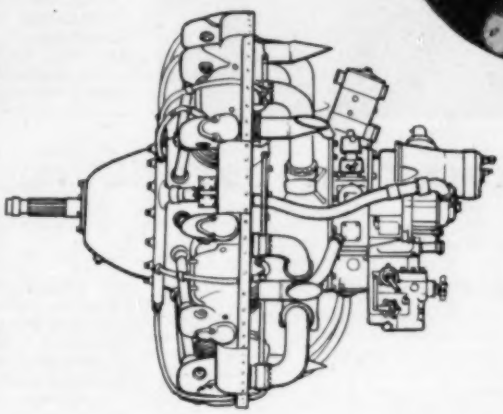
Commonwealth Cicada During World War 2, the Commonwealth Aircraft Corporation licence-produced the Pratt and Whitney R-1340 Wasp and R-1830 Twin Wasp radials, in considerable numbers. After the war, the design of a wholly Australian engine was commenced, and great care was taken to permit the use of the greatest possible proportion of the existing dies, jigs and general tooling which had been used on the Pratt and Whitney designs.

The resulting engine, the Cicada, is therefore to some extent similar to the American designs (it most nearly resembles a Wasp Junior) but incorporates various features of its own, such as an 8 : 10 reduction gear, with a pinion driving an internal annulus gear, and an almost complete absence of ball bearings. The eventual aim is to obtain an overhaul period of at least 1,200 hours. The rear section of the crankcase, of cast magnesium alloy, can carry a generator, vacuum pump, hydraulic pump, air compressor, tachometer, airscrew governor, oil-pressure transmitter, fuel pump and starter; an updraught induction system is employed, with a Bendix injection carburettor.

The Cicada is now almost fully developed, and it is going into production at the Lidcombe factory for the Winjeel trainer, for which it will be the standard engine from aircraft No. 30 onwards.



C.A.C. Cicada seven-cylinder, air-cooled radial, with small 10 : 1 blower and 0.8 : 1 reduction gear. Injection-type carburettor. Bore, 5.375in; stroke, 5in; swept volume, 795 cu in (13.1 litres); diameter, 46.5in; length, 38in; dry weight, 770 lb; maximum power, 450 h.p. at 2,600 r.p.m. at sea level.

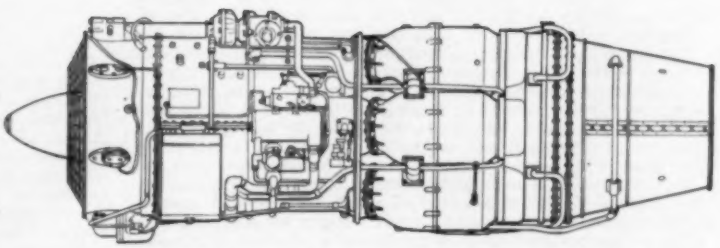


Avro Canada Orenda This powerful turbojet was the first engine designed in any part of the Commonwealth to go into production. Avro Canada's new design team first gained experience with the essentially similar, but smaller, Chinook turbojet which ran early in 1948. The prototype Orenda, roughly contemporary with the early Avon, was bench-run in 1949.

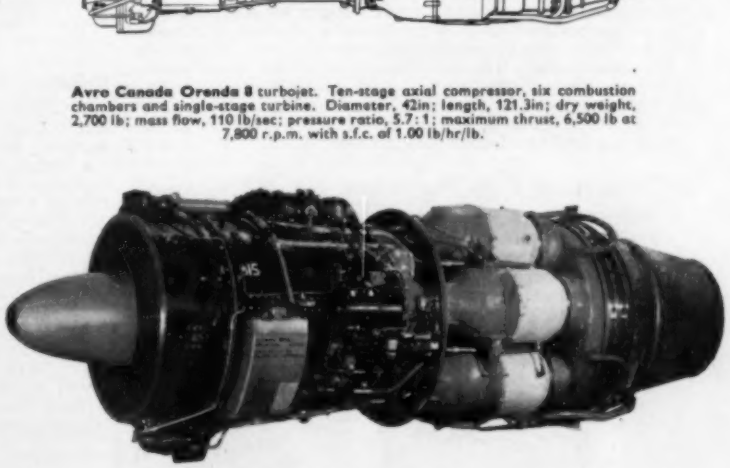
The Orenda has a 10-stage axial compressor, the efficiency of which has been steadily improved during successive marks of the engine. Six large, tubular combustion chambers are fitted, with duplex burners in the cast diffuser sections. Equipment includes an intake screen and full anti-icing; when installed in the CF-100 Mk 4 fighter the Orenda is fitted with a windmill on the intake spinner which sprays alcohol around the intake periphery.

The early Orenda 2s were 6,000 lb-thrust engines; they were followed in production by the 6,500 lb Orenda 8 and 10, and the engines now in production are the Mks 11 and 14, for the latest types of CF-100 and Sabre. Both these engines have two turbine stages, give over 7,000 lb thrust and have a specific fuel consumption below unity. Early this year the 1,000th Orenda was delivered, on schedule, and many have been made since.

Avro Canada also have an extremely large and powerful axial turbojet running in prototype form, for eventual installation in the CF-105 fighter.



Avro Canada Orenda 8 turbojet. Ten-stage axial compressor, six combustion chambers and single-stage turbine. Diameter, 42in; length, 121.3in; dry weight, 2,700 lb; mass flow, 110 lb/sec; pressure ratio, 5.7 : 1; maximum thrust, 6,500 lb at 7,800 r.p.m. with s.f.c. of 1.00 lb/hr/lb.



The impressive setting for Alcan's Kemano Camp No. 5, British Columbia. Auxiliary camps are located at 1,600 and 2,600ft.

THE CANADIAN INDUSTRY . . . (*Continued*)

—ANCILLARY COMPANIES

Aluminium Company of Canada, Ltd.

CANADA owes her pre-eminent position as an aluminium-producing nation to her great hydro-electric developments. Last year's production by the Aluminium Company of Canada (Alcan) amounted to 545,800 tons. Although consumption in Canada has been increasing steadily since 1945, Alcan still exports over 80 per cent of her primary metal; in 1953, for example, the U.K. imported 184,600 tons of aluminium from Canada, about one-third of the Dominion's total Canadian production.

In addition to smelters at Arvida, Isle Maligne, Shawinigan Falls and Beauharnois, all in Quebec Province, and now Kitimat, the company has fabricating plants at Kingston and Etobicoke in Ontario, Arvida and Shawinigan Falls in Quebec. The Kingston plant has been producing high-strength aluminium aircraft alloy sheet, extrusions and forgings in increased quantities. Etobicoke is supplying mould, die and sand castings.

Alcan's importance as a large-scale supplier of aluminium alloy ingot and fabricated components to the world's aviation industries is enhanced by its having available the research facilities of Aluminium Laboratories, Ltd., its sister company in the Aluminium, Ltd., group. Aluminium Laboratories, with a staff of over 400 working in modern research laboratories at Kingston and Arvida in Canada, and Banbury in England, carries on extensive research in production, alloying and fabrication techniques.

Alcan's position is now strengthened by the new production facilities at Kitimat, British Columbia. When fully in operation, the Kitimat smelter will augment Canadian production by 91,500 tons per annum. The project has been designed and planned for an ultimate 550,000 tons annually, which will duplicate present production capacity in eastern Canada. Power for Kitimat comes from an underground power-house located at Kemano, fifty miles distant. Water from a series of high-level lakes feeds the turbines at Kemano through a ten-mile-long, 25ft diameter tunnel which has a drop sixteen times that of Niagara Falls. When the project has been developed to its fullest extent Kemano will have an installed generating capacity of 2,200,000 h.p.

Address: 1700 Sun Life Building, Montreal, P.Q.

Bristol Aeroplane Engines of Canada, Ltd. and Associated Companies

IN 1929 a licence to manufacture was granted by Bristols to Aero Engines of Canada, Ltd. This company controlled two others, British Aeroplane Engines, Ltd., and Canadian Wright, Ltd. Both these organizations, which for a time shared the same premises, undertook Bristol engine servicing. Later the companies separated from each other and from Aero Engines. Canadian Wright continued the work in Montreal, and British Aeroplane Engines mainly in Vancouver with a Montreal office.

Not until after the war, in 1950, did the Bristol Aeroplane Company of Canada come into being when it took over the Vancouver factory and its headquarters office in Montreal, and this phase of the story was completed when in 1951 Bristols also purchased the Canadian Wright organization in Montreal.

Since then a fine new factory has been built in which work started in May, 1953. The two companies which were taken over were renamed Bristol Aeroplane Engines (Western), Ltd., in the case of the Vancouver concern, and Bristol Aeroplane Engines (Eastern), Ltd., for the Canadian Wright organization. More recently a further change in name has been made, and Bristol Aeroplane Engines (Eastern), Ltd., has now become Bristol Aero Engines, Ltd., while the name of the Vancouver company was slightly modified to become Bristol Aero Engines (Western), Ltd. A few weeks ago, on July 31st, a third organization came under Bristol control with the purchase of all the shares of Macdonald Aircraft, Ltd., of Winnipeg.

The activities of all the companies named have been concerned almost entirely with overhaul and repair work, although Bristol activities may be said to have started in Canada when a Jupiter 6A was installed in a Vickers Universal built under licence by Canadian Vickers—this was in 1929.

During the war years Canadian Wright in Montreal overhauled more than 3,000 engines, including Pegasus 10, Mercury 15 and 20, and Perseus. Following a flat period after the war, 1948 brought Centaurus-engined Sea Furies into Canadian Naval service, and since that time the company's activities have increased. Work now in hand includes overhaul, servicing and modification of Rolls-Royce and Packard Merlins, and of Wright Cyclones for the R.C.A.F., of Centaurus and Cyclones for the R.C.N., of Cyclones and Hercules for T.C.A., and of Hercules for Associated Airways and Maritime Central Airways.

The show-piece of the Bristol companies in Canada is the new factory at Montreal, to which reference was made above. The plans were approved and the site chosen early in 1952, and in June work started. In just under twelve months operations began in the completed building, of some 155,000 sq ft floor space, the cost of which was some $3m. This Bristol Aero Engines, Ltd., factory now employs some 825 people, including those in associated premises in east Montreal which have some 43,000 sq ft of area devoted to testing and storage. Bristol Aero Engines (Western), Ltd., occupies some 40,000 sq ft and employs 200.

The president of Bristol Aeroplane Engines of Canada, Ltd., is Sir Reginald Verdon Smith, and the executive vice-president in Canada is R. J. Reynolds. Previously sales manager of the companies, Mr. W. S. Haggett was recently put in charge of the Winnipeg company as executive assistant to Mr. R. J. Reynolds who was at the same time appointed its president. General manager of Bristol Aero Engines (Western), Ltd., is J. Holt, and the works manager is L. W. Smith. The manager (engineering) of Bristol Aero Engines, Ltd., is J. R. Hutton.

Address: 10210 PieIX Blvd., Montreal North, Quebec.

Canadian Aviation Electronics, Ltd.

CANADA'S largest Canadian-owned electronics company, this concern employs some 1,300 people and possesses manufacturing facilities from coast to coast. Seven years ago, when the company was founded (in a hangar at St. Hubert Airport, near Montreal), the number of employees was three. The newly-opened headquarters plant at Montreal comprises 130,000 sq ft of electronic manufacturing products; there are 55,000 and 12,000 sq ft at Winnipeg and Vancouver respectively; and a new 12,000-sq ft plant is planned for Toronto.

The company's special equipment includes a complete range of the specialized test and measuring devices for aviation electronics, with special emphasis on microwave test equipment.

Products embrace flight simulators (including an electronic

Bristol executives in Canada: (left to right) R. J. Reynolds, executive vice-president; J. A. Limoges, vice-president and secretary treasurer, W. S. Haggett who recently took charge at Winnipeg.

simulator for the CF-100), northern radar defence installations, a wide range of radio and communication devices and instruments, with special emphasis on nucleonic devices, radar fire-control for fighter aircraft, pneumatic and hydraulic systems, and also a number of V.H.F. omni-range systems. For the future, the production of additional flight simulators is planned, together with V.H.F. mobile equipment and nickel-cadmium batteries. C.A.E. are now Canadian manufacturers of Lear autopilots.

Executives include K. R. Patrick (president and managing director), R. W. Cooke (chief engineer), R. R. Desaulniers (executive vice-president) and T. L. Redfern (secretary-treasurer).

Address: 8,280, St. Lawrence Blvd., Montreal.

Canadian Marconi Co.

SINCE its establishment in 1902—a year after Marconi received, in Newfoundland, the first transatlantic wireless message—the company has been the exclusive agent in Canada of the English Marconi Co., and has been entitled to the same rights in Canada as have Amalgamated Wireless in Australasia. In 1953 the links were further strengthened when the English Electric Co. (of which Marconi's Wireless Telegraph Co., Ltd., is a subsidiary) purchased from Cable and Wireless, Ltd., the latter's majority shareholding in the Canadian Marconi Co. Thus, the resources in research, development and production both of Marconi's Wireless Telegraph Co., and of English Electric are fully available to the Canadian company, and *vice-versa*.

The aviation side of the Canadian organization is comparatively young, yet at the present time is in a position to offer a complete range of equipment and full repair and maintenance service. It is responsible for servicing all radio equipment in the R.C.A.F. Comets, and will shortly be responsible for the maintenance of the Marconi radio-compasses in T.C.A.'s Viscounts.

Executives include S. M. Finlayson (president), J. J. Kingan (general manager), C. E. Tremblay (manager, aviation department).

Address: 2442 Trenton Avenue, Montreal 16.

Canadian Steel Improvement, Ltd.

IN January of this year the establishment by the Hawker Siddeley Group of a Canadian subsidiary of High Duty Alloys, Ltd. (Slough), was announced. Three months later High Duty Alloys (Canada), Ltd., acquired the 60,000-square-feet plant of Canadian Steel Improvement, a company at Etobicoke, North Toronto, specializing in precision forgings in aluminium, steel and titanium for gas-turbine engines. Following a visit to Canada, Sir Roy Dobson stated that the Hawker Siddeley Group intended to expand the C.S.I. facilities and to specialize even further in titanium. The plant was originally completed in 1951.

At present, the factory includes two forging shops (for steel and high-temperature alloys, and aluminium respectively) and a die shop. Among the equipment primarily used for the manufacture of turbine blades are a range of 1,500-3,000-lb Ceco air hammers, with suitable coining presses, heat treatment and conditioning equipment. Also available is a 5,000-ton hydraulic press, together with a 2,200-ton mechanical press on which forgings up to approximately 25 lb can be handled.

Plans are in hand for the extension of the present forging facilities by the introduction of larger hammers and presses, which will result in a range of equipment able to deal with the largest forgings forseeable in the Canadian aircraft industry. A sand and gravity die-cast foundry for both aluminium and magnesium is also to be laid down, in which the H.D.A. range of Hiduminium and Magnuminium casting alloys will be produced. In the development of forging technique for titanium the company is well advanced and is expected to be one of the main sources of supply for this type of forging in Canada.

The directors of the company include Sir Frank S. Spriggs, Sir Roy H. Dobson, Crawford Gordon, Jr. (Avro Canada president), C. J. Luby (president and general manager), and F. McAlpine (secretary-treasurer). The chief engineer is I. A. Usher. Address: Box 32, Station N, Toronto 14.

Decca Radar (Canada) Ltd.

FORMED as a subsidiary of Decca Radar, Ltd., England, in July this year to further the expansion of the parent company's activities in Canada, the company has, in addition to its Toronto headquarters, branch offices in Montreal and Halifax, and established sales and service agents at other principal ports.

Though essentially concerned with the sale, installation and service of Decca radar, it also represents in Canada the Decca Navigator Co., Ltd. Products handled are airfield control radar, storm-warning radar, radar link, microwave test-gear, marine and harbour radar and the Navigator system.

Following the introduction of Decca marine radar to the Canadian market, attention is now being given to the requirements of the aviation industry, and trials of Decca airfield control radar are now being conducted by Service and civil authorities.

L. J. Dennett is general manager of the Canadian Company.

Address: 1175 Bay Street, Toronto 5.

Dowty Equipment of Canada, Ltd.

ONE of the principal war-time suppliers in Canada of hydraulic equipment and landing gear, Dowty were established in Montreal in 1941. When the exceptional demand ceased in 1945, a much smaller service, sales and liaison organization continued to look after Dowty affairs until development in Canada once again created a demand for a manufacturing organization.

The Ajax area, where Dowty found their first post-war manufacturing premises and where their new factory is now situated, is near the town of Oshawa. It came into being during the war when a large dispersed ammunition factory employing nearly 10,000 was sited there. Dwellings and the central services—power and heat—have been maintained, and many of the buildings are being put to good use today.

Dowty is one of many firms in Canada whose main work is concerned with one major aircraft—in this case the CF-100—for which undercarriage units and jacks are made. But it must be added that the company's activities involve some three hundred different units for fifteen separate aircraft types. Among overhaul contracts in hand are those for Lancasters, Vampires and Sea Furies; early CF-100 material is also back.

A visitor to the new factory cannot but be struck by the pleasant atmosphere—the light and airy departments and, as at the Dowty parent factory, the cleanliness and the high standard of finish on components.

Some 350 people are engaged on Dowty work. In the new factory the activities are mainly concerned with production; in the old factory it is overhaul and repair work, and some ingenious test rigs as well as the more standard test equipment have been built or installed. Lancaster components were conspicuous here on the occasion of our visit. Midway between these two sections another group of the older buildings houses a department for degreasing, anodizing and similar processes.

The vice-president and general manager is R. F. Hunt, himself a Dowty apprentice and responsible for the formation of the Canadian company after the war. He is assisted by the technical director, I. M. Hamer. A. R. Read is in charge of the repair and overhaul section. Address: Ajax, Ontario.

The Fairey Aviation Co. of Canada, Ltd.

ALTHOUGH Fairey's Canadian organization is not engaged in the manufacture of aircraft, it is nevertheless one of the most important establishments for major overhauls, repairs, refits and modifications. Like the parent company at home it has been mainly concerned with Naval aircraft—for the Royal Canadian Navy—but recently more Air Force work has also been undertaken with the promise of still more to come.

The company was formed in November, 1948, with the main purpose of servicing Canadian Naval aircraft, and it was thus convenient for the head office and works to be situated at Eastern Passage, Halifax, Nova Scotia. Fortunately suitable premises, then unoccupied, had been built for R.C.A.F. aircraft overhaul work during the war, and these were taken over by the newly formed company. At the time the Canadian Navy were operating Fireflies and Seafires, repair and maintenance of which was handled by a Canadian concern. By agreement the work was taken over by Fairey's at the Dartmouth factory, and it was not long before about 100 people were engaged on the work. One of the first major jobs tackled by the new company was the conversion of the Grumman Avenger for anti-submarine duties. This was during the latter part of 1950 and subsequently.

A year later a rather different kind of work was added to the activities of Fairey Canada as a result of an R.C.A.F. contract for the overhaul of fifteen Mk 10 Lancasters and the conversion of some for long-range navigational training duties. The first of these machines was handed over ready for service within five months of receipt from storage. More space and more hands were needed, and, as a result, within four years of the formation of the company the floor space has been increased from some 130,000 sq ft to 210,000 sq ft, and the labour force from 50 to 500 in three years to nearly twice this figure today.

In his report of activities at the beginning of this year Mr. C. L. Hibbert, managing director, said that 850 employees occupying an area 60 per cent greater than when the company started were fully occupied with Avenger conversions and modifications, with the de-mothballing and converting of Lancasters, and with the overhaul of Sea Furies. The new machine shop was shortly to receive manufacturing work for Fairey power controls, and facilities had been set up for the manufacture under subcontract of Hydro booster units for the controls of the Avro CF-100. This new section, employing more than 100 people, will shortly be in full production, and it is possible that Hydro booster units will be ordered for the CF-105, in addition to those already required for the CF-100.

To the Naval work already mentioned is added the repair and overhaul of Sea Furies, and there is every reason to believe that the Grumman S2-Fs and McDonnell Banshees, of which considerable numbers are to be delivered to the Canadian Navy, will

THE CANADIAN INDUSTRY . . .

be maintained by Fairey's and possibly modified and fitted to Canadian Navy standards by the company before delivery.

Sir Richard Fairey is the president of the Canadian company, and the vice-president is Mr. S. G. Dixon. Mr. Charles Hibbert rose from director and general manager to managing director in January this year. It was he who was mainly responsible for the formation of the Canadian company, having joined the parent Fairey company at Hayes in 1919. Before settling in Canada he also had a wide experience of Fairey activities at Hamble and overseas. Mr. E. C. Garrard is chief designer and Mr. A. C. Earle works manager. The secretary and treasurer is Mr. A. M. Cameron. Address: Eastern Passage, Halifax, Nova Scotia.

Godfrey Engineering Co., Ltd.

THIS is a subsidiary of Sir George Godfrey and Partners, Ltd., of Hanworth, Middlesex, designers and manufacturers of cabin pressurization and air-conditioning equipment. Godfrey Engineering was established in Canada in 1947 as a sales and service facility for the British company, but two years later it was decided to build a manufacturing plant in Montreal. The cabin superchargers and refrigeration units for the CF-100 which were manufactured there, constituted the first equipment of this kind ever to be manufactured in Canada.

Godfrey cabin superchargers were installed in T.C.A.'s North Star aircraft in 1948 in place of the original American equipment and, together with the firm's refrigeration units, will also be in North American service in the Viscounts of both T.C.A. and Capital Airlines. In addition to the airborne products manufactured, the Canadian company specializes in the manufacture of aircraft ground-servicing equipment especially designed for North American climatic conditions.

Development is continuing on new items of both airborne and ground air-conditioning equipment, including a single-stage dry-air pump, now undergoing flight trials, for use with Goodrich high-pressure de-icing boots. The company acts as Canadian representatives for the Pacific Airmotive Corporation of Burbank,

The Montreal plant belonging to Godfrey Engineering, Canadian subsidiary of Sir George Godfrey and Partners.

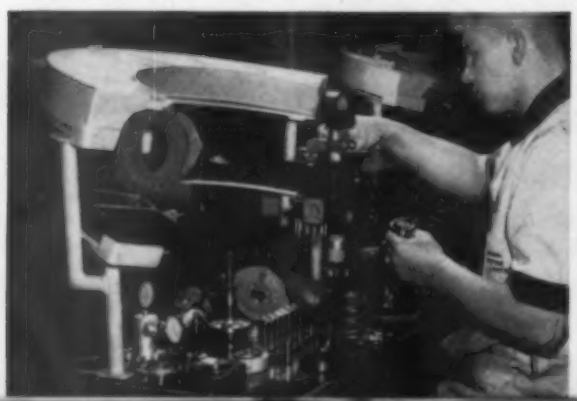
California, manufacturers of cabin pressure-control equipment and valves. Executives include W. F. S. Carter (president and general manager), J. A. Davis (vice-president), W. D. L. Theed (vice-president), E. D. Cornell (secretary-treasurer), and R. L. Simming (works manager).

Address: 480 Metropolitan Boulevard, Lachine, Montreal 32.

International Nickel Co. of Canada, Ltd.

THIS company are major producers of nickel, as widely used in the aircraft industry and, in particular, for gas-turbine alloys (e.g., Nimonic and Inconel). The company conducts concentrating and smelting operations in the Sudbury district of Canada and refines at Port Colborne. It also operates foundry and rolling divisions through its subsidiary, International Nickel., Inc., of U.S.A., at Bayonne and Huntingdon.

In addition, another subsidiary, the Mond Nickel Co., with its



The Fairey Aviation plant at Dartmouth, Nova Scotia.

controlled company, the Henry Wiggin Co., Ltd., conducts reduction and fabrication operations in the U.K. International Nickel and its subsidiaries employ 27,500 men, and at the present time is operating at a nickel production rate in excess of 275 million pounds per year. It also produces substantial amounts of copper, and is an important producer of the platinum groups of metals. Executives include: Dr. J. F. Thompson (chairman), H. S. Wingate (president), and J. R. Gordon and L. H. Cooper (vice-presidents). Address: 25 King Street West, Toronto.

Lucas-Rotax, Ltd.

THE formation in February 1949 of Lucas-Rotax introduced to Canada the combined experience of two well-known British companies, Joseph Lucas, Ltd. (aircraft gas-turbine fuel systems) and Rotax, Ltd. (electrical equipment). The company's manufacturing plant, of 120,000 sq ft, is located at Scarboro, Ontario, while the service department, responsible for the servicing of all the company's products, covers one-tenth of this space in Montreal. A total of some 750 people are employed.

Fuel systems for the Rolls-Royce Nene and the Avro Canada Orenda, and electric starter equipment for the Nene, are among the company's present production commitments. The manufacture of spares for the Nenes fitted to R.C.A.F. aircraft is also continuing. On the research and development side, work is proceeding on special equipment for guided missiles, the adaptation of the Lucas de-icing heater for normal aircraft heating, and components for new Avro Canada aircraft and engine projects.

Modern production methods and special management training courses are two of the factors which have led to the achievement of effective and cost-conscious results in this young engineering organization. The top executives include A. B. Waring (president), F. Garner (executive vice-president), E. F. Richardson (vice-president and general manager), J. Hulbert (vice-president and commercial manager), and W. E. Jones (chief engineer). Address: Box 115, Station H, Toronto 13.

Noorduyn Norseman Aircraft, Ltd.

THIS company are in effect successors to Noorduyn Aviation, Ltd., of which they were formerly a wholly-owned subsidiary. Originated in 1942, they were reactivated in 1953 for the purpose of continuing the service of the Norseman 8/10-seater single-engined transport, approximately 1,000 of which were built by Noorduyn Aviation, Ltd., at Montreal before and during the war

(left) Modern production methods are used at the Lucas-Rotax plant. The photograph shows a pump-assembly operation. (Below) One of the early Norseman aircraft built by Noorduyn Aviation. Noorduyn Norseman Aircraft, Ltd., are successors to this firm.

(manufacture was continued from 1946 to 1952 by the Canadian Car and Foundry Co., Ltd.).

As owners of the manufacturing rights, drawings, tools, engineering data, etc., Noorduyn Norseman Aircraft (who have a plant on the outskirts of Montreal, near the Cartierville airport) provide spare parts, commercial conversion kits, engineering services, etc.

An associated organization, Aircraft Parts and Supplies, Regd., handles the sale of parts and supplies for Harvard aircraft, this type also having been produced by Noorduyn during the war.

Executives of Noorduyn Norseman include R. B. C. Noorduyn (vice-president and general manager), Austin Latremouille (secretary and sales manager), and Joseph Zinnato (director).

Address: 151 Marcil Street, St. Laurent, P.Q.

Normalair (Canada), Ltd.

IT was in December 1952 that this company was established to look after the interests of the British Normalair company (Yeovil), and in particular to provide servicing and overhaul facilities and engineering assistance to Canadian users of Normalair equipment. The second main objective of the company is to maintain close technical liaison with the Canadian Defence Departments, the Services, experimental establishments and aircraft manufacturers, and to feed back appropriate information to the parent company.

The parent company's range of products comprises aircraft pressurization, oxygen and personal breathing equipment. The repair, overhaul and design liaison facilities at Toronto include altitude chambers and other test equipment. Manager at Toronto is P. G. Browne. Address: 922 King Street West, Toronto.

Photographic Survey Corporation, Ltd.

THIS organization was established in 1946 and has grown within a few years into "the largest and most diversified air-survey firm in the world." With its associates, referred to below, it is a company of the Hunting Group. Among P.S.C.'s major assignments have been a 127,000-square-mile forest inventory for the Government of Ontario; a mapping and resources-reckoning air survey for the Government of Alberta covering 185,000 square miles, now nearing completion; and the five-year $2,000,000 resources inventory of West Pakistan, now in its second year. Typical private concerns served include mining and oil companies (geological and aeromagnetic exploration surveys), railroads and pipeline companies (location surveys), and real estate and town-planning firms (large-scale plans). P.S.C. also does a great deal of large-scale mapping for city authorities.

As P.S.C. grew, associate companies were established to carry out the many specialized functions required in air-surveying. In 1947, *Kenting Aviation, Ltd.*, Municipal Airport, Oshawa, Ontario, was established as P.S.C.'s aircraft operating company. Kenting today operate three Anson 5s, four Hudsons, one Lockheed 14, two Mosquito FB-26s, one Sea Hornet, one Canso, one Cessna 180, five Hiller 360 helicopters and one B-17G.

Also in 1947, to service its aircraft, P.S.C. bought an aircraft operating company outright, and in 1951 re-formed this company as *Field Aviation Co., Ltd.*, with a main base at Oshawa. Field's original function was to service Kenting aircraft only; but contract servicing from the R.C.A.F. and other clients rapidly expanded their facilities. To supplement these technical services, Field's engaged in sales of aircraft and aircraft equipment. Today they are Canadian sales representatives for such well-known British companies as Smiths Aircraft Instruments, Ltd., Bryans Aeroquipment, Ltd., G.Q. Parachute Co., Ltd., Fireproof Tanks, Ltd., Blackburn-Turbomeca (aircraft and industrial gas turbine engines), Ulster Weaving Co. (aircraft fabrics), Murex Welding Processes, Ltd. (ground starter equipment), Boosey and Hawkes electronic division, and Frankenstein and Sons (Manchester), Ltd. (air/sea rescue equipment, high-altitude clothing). Field's are also Canadian agents for Hiller helicopters. The company's growth was further reflected by establishment of aircraft servicing shops at Calgary Municipal Airport in 1952.

Other P.S.C. associate companies include *Aeromagnetic Surveys, Ltd.*, established in 1950 to meet the increasing demand for airborne magnetics. A.S.L. have carried out airborne magnetic surveys in all parts of Canada and, recently, in New Guinea. Another associate is *P.S.C. Applied Research, Ltd.*, established in 1951 when P.S.C.'s own research work, and that which it did for outside clients (including the R.C.A.F.), expanded beyond the scope of a company division. P.S.C. Applied Research specializes in design and production of electronic, mechanical and optical devices used in industry, air survey, navigation and many other fields. Like its parent company, it has also expanded, and in 1953 moved into a new building which trebled its productive capacity.

Regional associate companies are: *Photographic Surveys (Quebec), Ltd.*, at Montreal, and *Photographic Surveys (Western), Ltd.*, at Vancouver.

In 1954, a Canadian holding company, *Hunting Associates, Ltd.*, was formed to direct and integrate the activities of all these companies. Other holding companies, dealing with overseas interests, are *Photographic Surveys (Overseas), Ltd.*, and *Aeromagnetic Surveys (Foreign), Ltd.* The executives of the Photographic Survey Corporation include D. N. Kendall (executive vice-president) and W. H. Godfrey (general manager). Address: 1,450 O'Connor Drive, Toronto.

Pye Canada, Ltd.

IN the choice, in 1948, of Ajax as a plant location Pye Canada had the distinction of being the first company to begin operation in an area which, situated 22 miles east of Toronto, is quickly becoming a busy industrial community.

The company's operations in Canada embrace all products of the Pye Group which have market application in the Dominion. The progress of the telecommunications division has been steady, many firms connected with the aircraft industry using Pye ground communications equipment. The Department of Transport has standardized the company's equipment for airfield vehicles, having some ninety sets in operation, as also have the Calgary and Vancouver municipal airports.

A number of aerial survey companies (e.g., Spartan Air Services, Kenting Aviation, and Canadian Aero Survey) use Pye equipment in their aerial survey and mapping in outlying areas such as the Yukon and North-West Territory, having reporters in the aircraft—which are principally helicopters—and A.C. or battery fixed stations on the ground to maintain continuous communication. A P.T.C. 704 fixed station is also used by the Government's ice-breaker *D'Iberville* for communication with its helicopter.

For telephone installations Pye Canada, Ltd., represents Ericcson Telephones, Ltd., of England, in Ontario and Quebec, and also markets scientific instruments made by W. G. Pye, Ltd., and Unicam Instruments Ltd., both of Cambridge, England. Executives include W. Jones (managing director), I. Nixon (sales director), and A. C. Pitt (secretary-treasurer).

Address: Ajax, Ontario.

R. F. D. (Canada), Ltd.

FORMED in December 1951, this company is a subsidiary of the British R.F.D. company at Godalming, Surrey. The factory premises are located in Granby, P.Q., cover a floor area of 15,000 sq ft, and are devoted to the manufacture and repair of all types of air/sea rescue equipment. Overhaul and repair work on such equipment is performed for the R.C.A.F. and R.C.N.

The directors of the company are: A. Van Beugen Bick (chairman), R. E. Lloyd (president), Mrs. M. E. Gall (vice-president), Miss J. E. W. Beer (secretary-treasurer), and K. A. Wilson.

Address: 464 St. John Street, Montreal.

Simmonds Aerocessories of Canada, Ltd.

THIS company serves the Canadian aircraft industry by supplying specialized instruments and components, such as the Simmonds Pacitron fuel measuring system, the Simmonds push-pull control, and a wide range of high-strength access and cowling latches. Simmonds Pacitron gauges are fitted to T.C.A. Viscounts.

Another product consists of Hi-Shear rivets, as supplied in large quantities for the Canadian-built F-86 and for the Avro Canada CF-100. New and improved Hi-Shear fasteners are also becoming available. British manufacturers represented in Canada by Simmonds include Saunders Valve Co., Ltd., and Graviner Manufacturing Co., Ltd. The company is under the management of Robert G. Huggett. Address: 5800 Monkland Avenue, Montreal 28.

Sperry Gyroscope Co. of Canada, Ltd.

THE Canadian Government's aim of a self-sufficient Canadian aircraft industry has resulted in the establishment of many new factories. One of these, newly-built and excellently equipped to produce instruments and controls, is operated on a management basis by the Sperry Gyroscope Company. The germ of this

The Canadian R.F.D. Company does much work for the Services. Here, R.C.N. life-jackets are being packed.

The Sperry Gyroscope Company's modern plant on the Cote de Liesse Road, Montreal, where 800 people are employed.

idea had been in some people's minds since 1948, the risk of a serious instruments bottleneck having been foreseen. As a result Canadian Sperry was formed late in 1950. Prior to this the company's interests, and those of the Kollsman organization, had been looked after by the Ontario Hughes Owens Company.

The new small Canadian Sperry company at first simply represented the New York and London Sperry company, but very soon the plan for the Government factory was put in hand, and temporary space was taken at Dorval Airport to build up the nucleus of the management and staff of the new factory when it should be ready.

August, 1951, saw the start of the fine modern building on the outskirts of Montreal, and in July, 1952, it was completed. At this same time Sperry bought the Ontario Hughes Owens Company of Ottawa, and this separate overhaul organization is mentioned later.

To meet the very tight delivery dates for the Government's first instrument contracts, help was sought from both Sperry in New York and the Department of Defence Production. The first shipment of goods left the factory within ten months of the order.

In the new 90,000 sq ft factory has been installed more than $3m.-worth of equipment. Of all our works visits in Canada none was more fascinating than that to Sperry where the work is very varied and carried out in ideal conditions. The company has profited by close liaison with the immigration authorities in having some first-class European instrument makers steered its way. Near 800 people are now employed.

Products which call for special mention are Gyrosyn compasses, used by the R.C.A.F., R.C.N., T.C.A. and C.P.A., the Kohlsman machmeter for the Sabres, the Kohlsman mach/A.S.I. for CF-100s and the 50,000ft altimeter for both of them. The first contracts for quantities of the order of 1,000-off of each instrument have now mostly been doubled. The factory is already working almost to capacity. A new contract which Sperry expect to be important to them is for the overhaul of navigational equipment for the Royal Canadian Navy. Sperry Canada supply the American-made A-12 Gyropilot, Zero Reader and engine analyzer.

At Ottawa, Sperry has another affiliated company which occupies premises of 40,000 sq ft floor space. Known as Sperry Gyroscope Ottawa, Ltd., it is concerned with overhaul of instruments and employs about 300 people on that work. An important current overhaul job is that of gun-bomb-rocket sights of the computing type.

The managing director of Sperry Gyroscope Co. of Canada, Ltd., is B. W. King; K. Marshall is controller; and B. D. Russell sales manager. The address is Box 6121, Montreal, Quebec.

THE AUSTRALIAN INDUSTRY . . . (*Continued*)

—ANCILLARY COMPANIES

Amalgamated Wireless (Australasia), Ltd.

THIS company was founded in 1913, and ever since then it has had the exclusive licence to use Marconi patents in Australasia, and has had access to the designs and technical knowledge of the Marconi company in England. However, A.W.A. manufacture a wide range of radio equipment to their own design, and a considerable quantity of their aeronautical radio equipment is used by a number of Australian airlines, including Qantas Empire Airways. Some of the company's most important activities are in the servicing field, and among the airlines which are serviced by them are Qantas and all other Australian domestic airlines, as well as B.O.A.C., K.L.M., Pan American Airways, and Canadian Pacific Airlines when required. Radio service is also provided by A.W.A. for the R.A.A.F., and for R.N.Z.A.F. Transport Command aircraft when in Australia.

The company's radio products include the VAN-3 series of 200-Mc/s distance-measuring equipment (a double-pulse system available for 100, 200 and 300 nautical miles range); the lightweight HAC-1 high-frequency transceiver; the HAC-2 120-channel receiver and the "Air-mite" V.H.F. transceiver for light aircraft use. Chairman of the Board is T. J. Parker, and L. A. Hooke is managing director.

Address: 47 York Street, Sydney, N.S.W.

Australian Forge and Engineering Pty., Ltd.

FROM two plants, one of 151,800 sq ft floor area of this company at Lidcombe and another of 75,000 sq ft (operated by National Forge Pty., Ltd.) at Brooklea, Victoria, some 10 per cent of the output in each case is for the aircraft industry. At Lidcombe are produced airframe and engine forgings and drop forgings in steel, copper alloys and light alloys, while Brooklea produces gas turbine blading in light alloys, aluminium bronze and Nimonic alloys. Current contracts are for airframe forgings for the Canberra and Sabre, and for Avon blades.

The materials and methods employed in producing light-alloy forgings are those evolved in association with the company's principals in Great Britain, who are High Duty Alloys, Ltd.

Originally established in 1931, the company greatly increased its aircraft work during the war: 1,150 different types of forgings in steel and light alloy were produced for the Wirraway, Beaufort, Beaufighter, Lancaster and Mustang, for P. and W. engines, and for D.H. engines and airscrews.

Address: Parramatta Road, Lidcombe, N.S.W.

The Bristol Aeroplane Co. (Australia) Pty., Ltd.

TWO distinct branches of aviation work are undertaken by the Bristol concern in Australia and two separate premises are employed for them. One is concerned with Bristol and other engine overhauls, the other with general aircraft maintenance. In addition sales of all the parent company's products, including cars and buildings, are looked after from the Melbourne office of the Bristol Aeroplane Co. (Australia) Pty., Ltd., under the general manager, Claud Tucker.

The evolution of the companies has been as follows: A concern known as Overseas Corporation, Ltd., for some time looked after Bristol interests in Australia and they were the sole shareholders in two subsidiaries, Airflite (Training), Pty., Ltd., at Bankstown, Sydney, and Aeronautical Supply Co., Melbourne. In 1952 the company named as in the heading was formed, and this took over half interest in the Overseas Corporation subsidiaries. The Overseas chairman, Sir John Storey, also became chairman of the new Bristol company.

About a year later, in March 1953, this new Bristol company acquired the other half interest in Airflite and renamed it Bristol Aviation Services, Pty., Ltd. At the same time a new additional factory was equipped for engine overhaul work. This is situated at Short Street about four miles from Bankstown and the aircraft section.

The old premises are retained for a variety of aircraft work, and during our visit we noted in particular that six Catalinas are being completely overhauled for the Dutch Government for duties with the Royal Netherlands Naval Air Service.

The first Bristol helicopter to receive a complete overhaul outside England was another job in hand. Sycamores of the R.A.N. and R.A.A.F. will receive their servicing from Bristol Aviation Services Pty., Ltd.

There are plans for an extension of the work undertaken and further approvals by the Department of Civil Aviation are being sought. Modern engine test facilities will probably be provided and the electrical workshops will be extended. Ultimately it is hoped to develop facilities to an extent which would enable Britannias to be handled and for this a test-house capable of taking the Proteus turboprop will be required.

The works manager of the Services Pty., Ltd., is J. A. Latham, previously technical sales representative.

The new Short Street engine overhaul section has a total area of 17,000 sq ft of which just over 14,000 are factory space. At

present there are facilities for handling three engines a week, and the well-equipped machine shop is to be further developed to permit manufacture of parts which would be costly and difficult to import into Australia. Engines at present receiving attention are Leonides helicopter units for the Sycamores of the R.A.N., Hercules engines for both R.A.A.F. and R.A.N., and Pratt and Whitney R-1830s from airlines.

Bristol's is one of the companies which operates an establishment at Salisbury in connection with the Woomera rocket range, but this has no direct connection with the other Australian establishments reviewed here and its work is concerned with secret products sent out from the British parent factory. F. L. Yorke is the superintendent at Salisbury.

Address: 414 Collins St., Melbourne.

Dowty Equipment (Australia) Pty., Ltd.

UNDER the technical control of the British parent company at Cheltenham, Dowty's 5,000 sq ft plant at Bankstown is responsible for the servicing and overhaul of aircraft landing-gear and hydraulic equipment. In addition, a variety of aircraft spares are stocked and distributed. At present the company is mainly engaged on the overhaul of aircraft equipment for the R.A.N. and the R.A.A.F.

Bankstown is the only plant in Australia engaged solely on the overhaul of aircraft hydraulic equipment. Future plans include an expansion to provide facilities for the overhaul and testing of fuel pumps and equipment for gas turbines.

In addition to G. H. Dowty, chairman of the parent company, P. F. Handcock and N. J. Nangle are directors of the Australian company. Address: Bankstown, Sydney, N.S.W.

Fairey Aviation Company of Australasia Pty., Ltd.

THIS company, which has become an important aircraft overhaul organization and handles practically all the aircraft of the Royal Australian Navy, was founded in March 1948 on a fifty/fifty basis between The Fairey Aviation Co., Ltd. (of England), and Clyde Industries, Ltd., of Sydney, N.S.W. The title was originally Fairey Clyde Aviation Co., Pty., Ltd. In February 1951, under a reorganization scheme, Clyde Industries sold its holding, and the present company was formed under the title of Fairey Aviation Co. of Australasia Pty., Ltd., with its premises at Bankstown Airport. In this company, the parent Fairey Aviation Co., Ltd., in England, holds the controlling interest.

The work in hand is mainly concerned with Firefly and Sea Fury overhauls, repairs and modifications.

Fairey Australasia at present leases its hangar premises from the Government, and thus changes and additions to buildings are not easily made. However, preparations are in hand to look after the R.A.N.'s Gannets when these are delivered. An addition of some 2,000 sq ft of area will be entailed.

During 1953, 32 Fireflies and 24 Sea Furies were delivered back to the R.A.N. In addition, 33 power plants and 450 spare components were also handed over. Of the 240 people employed, 180 are directly concerned with aircraft overhauls. The general manager is A. Cdre. C. B. Wincott.

On a recent visit *Flight* was able to examine the work in hand, admire the new office building with its very modern décor, and to inspect the new embodiment loan stores occupying 12,000 sq ft. Servicing sections are being developed and new systems adopted. The Fairey premises are surrounded by a high wire fence and at night dogs keep guard.

Experimental work is also undertaken at Bankstown, while at Salisbury, South Australia, Fairey's operate a missiles division in connection with the Woomera range. Col. R. T. Elvish is in charge there. Address: Bankstown, N.S.W.

Goodyear Tyre and Rubber Co. (Australia), Ltd.

THE Goodyear plant at Granville covers some 17½ acres, where aircraft work is combined with commercial tyre production. The company is a relatively old-established one, having been founded in 1927, and during the war it pioneered the production in Australia of self-sealing fuel tanks, aircraft wheels and brakes. For the aviation industry, the company's products comprise the well-known series of Goodyear aircraft tyres and tubes.

The company's directors include P. W. Litchfield (chairman), and H. C. Steiner (vice-chairman). Address: Granville, N.S.W.

Imperial Chemical Industries of Australia and New Zealand, Ltd.

COMMONLY known under the convenient short title of ICIANZ, this company manufacture chemical and allied products on a considerable scale in factories in Melbourne, Sydney and Adelaide. Among products of interest to the aircraft industry are polyvinyl chloride polymer; urea formaldehyde moulding-powders, syrups and resins; paint products; trichlorethylene, alkalis, and degreasing equipment; leathercloth; and nitric acid.

Polyvinyl chloride production at the Sydney factory is now sufficiently large to meet all Australian demands, including those for compounds, paste polymers and fabricated sheet. Leathercloth output includes both "Vynex" (p.v.c.-coated) and "Fabrex" (nitrocellulose-coated). Paint products are handled by a subsidiary, Balm Pty., Ltd., who manufacture a range equivalent to that of the I.C.I. Paints Division.

In addition to these Australian-manufactured items, ICIANZ are a selling organization for a wide range of I.C.I. products. Those available to the aircraft industry include Perspex acrylic sheet to D.T.D. specifications; heat-treatment salts; ethylene glycol; engine-starter cartridges; and isopropyl alcohol.

Chairman of ICIANZ is K. G. Begg, and J. R. A. Glenn is managing director. Address: 380 Collins Street, Melbourne.

Lucas-Rotax (Australia) Pty., Ltd.

THE merger of Joseph Lucas (Australia), Ltd., and Rotax, Ltd., into Lucas-Rotax (Australia) took place in 1951. Previously, the Joseph Lucas company at Melbourne, which had undertaken the servicing and overhaul of Rotax electrical equipment in 1937, had continued with this work until 1946 when the Australian Rotax company was formed.

Development since 1951 has led to the establishment of factories at Sydney and at Cheltenham as well as Melbourne, covering a total floor area of some 10,000 sq ft. The firm is approved by the Australian Department of Civil Aviation for the manufacture, repair, overhaul and modification of Lucas fuel systems and control equipment for gas turbines and Rotax electrical accessories and equipment, and, in addition, for the repair, overhaul and modification of Negretti and Zambra flowmeters, electrical accessories and equipment, fuel, vacuum and hydraulic pumps and associated control gear, ignition apparatus and armature windings. The distributing of Lucas, Rotax, Eclipse, Saunders, and Negretti and Zambra products is also performed.

At present, the Sydney factory is used for the testing of all fuel equipment (including turbine starters); the Cheltenham plant services all electrical and gas-turbine fuel equipment; and at Melbourne certain specialized test facilities are located.

Address: 81 Bouverie Street, Melbourne, Victoria.

Normalair (Australia) Pty., Ltd.

THIS company was established in 1952 with the two main objects of providing servicing, repair and overhaul facilities for Normalair equipment in use in the Australian area, and of providing liaison with the Australian Government and Services, the airlines and aircraft manufacturers.

The existing plant (a new one, at Essendon Airport, Melbourne, is about to go into operation) is equipped with altitude and other test chambers capable of testing all types of Normalair equipment in use in Australia. In addition, the new premises will be equipped to overhaul refrigeration turbines and a wide range of British and American equipment of an allied character.

The company has overhaul agreements with the Self-Priming Pump and Engineering Co. to look after their products in Australia, and also with Flight Refuelling, Ltd., for a similar purpose. An equivalent arrangement is being negotiated with the AiResearch Manufacturing company, of Los Angeles, which will enable Normalair to service that company's pressurization and air-conditioning equipment used in such aircraft as the Australian-built Sabre.

The plant manager is Ken Drew, who has many years' experience in the instrument field and in Australian aviation. Last year he visited the parent company's works at Yeovil for a period of training.

Earlier this year an association was formed with the National Instrument Corporation, a subsidiary company of Australian National Airways. Address: 70 Cape Street, Heidelberg, Victoria.

Rolls-Royce of Australia Pty., Ltd.

A new company which came into full operation this month, Rolls-Royce of Australia Pty., is a most important one both from the point of view of the parent company in Derby and because of the new potential and basis for future development which it brings to Australia. It is believed to be the first British self-contained gas-turbine overhaul establishment in the southern hemisphere.

Prior to the registration on November 14th, 1952, of this wholly owned Rolls-Royce subsidiary, R-R activities in Australia comprised liaison, sales and service. Rolls-Royce, Ltd., Australasian technical office in Melbourne continues to handle this work. Now the new factory has been completed—at a cost of £1½m—operators of Rolls-Royce gas-turbines are assured of complete overhaul and spares backing in this part of the world. Naturally, the decision of Trans-Australia Airlines to purchase Viscounts has influenced preparations for the first work to be put in hand. Overhauls of Avons can also be undertaken, and to quote the company on the scope of its activities "Comprehensive salvage and reclamation processes are included."

Lord Hives and Mr. J. D. Pearson are directors of the Aus-

THE AUSTRALIAN INDUSTRY . . .

tralian company, while Mr. Peter C. Birch, director and sales manager, heads the staff in Australia. Mr. A. H. Harvey-Bailey is a director and the chief engineer in Australia, and Mr. J. Mayne and Mr. S. Bruce are secretary and production manager respectively.

The situation of the factory on the boundary of Mascot airfield is very convenient. It comprises some 40,000 sq ft of shop and office space and a dual test-bed building of some 10,000 sq ft. The staff will number something over 200 according to present plans; six of the senior technical staff have been sent out from England. Some of the rest of the staff, recruited in Australia, are receiving training and experience in the U.K. The facility has been planned to provide for future engine developments up to units producing 12,000 lb thrust or 3,000 s.h.p.

In the first place quick and economical turn-round of civil gas turbines is the aim, but the military contribution which might be called for has not been overlooked. The factory is exceptionally well equipped and, for example, vertical assembly on hydraulic rams is provided for.

A special word must be said about the test-beds, costing £140,000, which are among the best silenced and best safety equipped anywhere. Automatic shut-down on all systems and flame-proofed wiring are included. The tank farm has foundations for 36,000 gallons of fuel and additional water-methanol capacity. For a start 24,000-gallon tanks have been provided.

To be able to offer in the S.W. Pacific area spares, service and complete overhauls will undoubtedly increase in the world market the attraction of aircraft fitted with Rolls-Royce gas turbines. The fact that all spares are immediately available in Australia will also result in a considerable saving to operators in the area, who will not have to invest nearly as much in spares of their own as would otherwise be the case.

The timing of preparations in the new factory is such that everything was in readiness to deal with Dart turboprops one month before the first T.A.A. Viscount was due for delivery. By now this machine, which was christened at Hurn Airport on July 22nd by Sir Thomas White, the High Commissioner, should be in Australia. Capacity is available to overhaul four Darts per week and a little later on three to four Avons per week as well. During the working-up period an engine sent out from Derby was used for practice in the use of tools, cradles, etc.

The Lucas equipment on Rolls-Royce gas turbines will soon be handled by a new factory in Roseberry, Sydney.

There is no intention that this new engine factory should have anything to do with Rolls-Royce cars in Australia, but it is probable that in the future the Rolls-Royce range of diesel engines will be handled and any other new Rolls-Royce engine products.

Reference was made above to the Rolls-Royce Australasian technical office; it may be added here that their liaison includes contacts with the Commonwealth Government in connection with licences for the Avon, Nene, Merlin and Griffon engines, with the Royal Australian Air Force on their Rolls-Royce products, and after-sales service to other users of Rolls-Royce military equipment in the south-west Pacific. Sales and service work of this office is also concerned with the whole of the south-west Pacific and with the Far East for aircraft and oil engines and cars.

Address: 46 Elizabeth Street, Melbourne.

Shell Company of Australia, Ltd.

THE Shell Transport and Trading Co. began operating in Australia in 1901, prior to the formation in 1905 of the British Imperial Oil Co. (a subsidiary of the Shell Group) to conduct the group's business in Australia. The name was changed to the Shell Company of Australia in 1927, and Shell Refining (Australia) Pty., Ltd., was formed in 1952.

The group's aviation service has provided fuel and oil for aircraft from the early days, and pioneered the refuelling points along the England/Australia route in association with Imperial Airways and Qantas. The company's service to aviation in Australia dates back to Ross and Keith Smith's flight in 1919, when bulk distribution was adapted to the needs of aircraft refuelling. Many refuelling points were remotely located and, before regular airline networks were established, the company operated its own aircraft for the inspection of these outposts.

The service has developed from the stage when aircraft were refuelled from two-gallon red cans, to the modern refuelling lorry having a capacity of 4,500 gallons and a delivery rate of some 300 gallons per minute.

Present facilities comprise a 1,800,000-tons-per-year refinery at Geelong, near Melbourne; a 420,000-tons-per-year refinery at Clyde, near Sydney; and 119 aircraft service points in continental Australia. In addition, a comprehensive network of fuelling points is maintained throughout the Pacific Islands, and on Cocos Island a complete service is maintained for the Sydney-Johannesburg Springbok route, the world's longest scheduled over-water flight. The total installation tankage for aviation fuels is 30,500 tons, and the number of aircraft fuelled last year was 63,616.

Chairman of Shell Refining (Australia) is E. N. Avery, who is also chairman of the local board of the Shell Company of Australia. Address: 163 William Street, Melbourne.

An illustration of the periscopic-sextant serviceability tester, one of the wide range of test facilities of S. Smith and Sons (Australia).

S. Smith & Sons (Australia), Pty., Ltd.

FOUNDED in 1948, this Australian subsidiary of the well-known British instrument-manufacturing organization has factories at Redfern and Ashfield, N.S.W., and aircraft instrument laboratories at Bankstown Aerodrome, N.S.W., and Melbourne. At the two latter, servicing, overhaul and repair of Smiths instruments are conducted, with similar facilities for the products of the American Kollsman and Liquidometer Corporations. At the Ashfield factory, K.L.G. automobile sparking plugs are manufactured, and there is capacity for the production of aviation sparking plugs and torch igniters.

Current contracts cover the entire instrumentation for the Australian Canberra and Vampire programmes and the C.A.C. Winjeel; and, together with Liquidometer and Kollsman, 70 per cent of the instrumentation of the Avon-Sabre.

Future planning includes full servicing facilities, particularly in relation to instruments of British manufacture, for the R.A.A.F. and for eventual operators of Viscounts, Comet 3s and Britannias.

The aviation division is expanding from the Bankstown Aerodrome servicing depot to another in the vicinity of Kingsford Smith Airport, Mascot. It is also equipping some 15,000 sq ft of instrument laboratories in Melbourne to serve Government and independent aircraft constructors.

A new factory at Granville, N.S.W., due for completion next year, will house the manufacture and servicing of a number of Smiths products, including K.L.G. plugs.

Chairman of S. Smith and Sons (Australia) is Lionel Hooke, who is also managing director of Amalgamated Wireless of Australasia and who was a former director of British Commonwealth Pacific Airlines. Address: 47 York Street, Sydney, N.S.W.

Vacuum Oil Co. Pty., Ltd.

THIS company, founded nearly 60 years ago, supplied fuel and oil to Australian aviation in its infancy and serviced many famous pioneer flights, including those of Sir Charles Kingsford Smith and (more recently) Capt. P. G. Taylor. It now markets and distributes a full range of aviation gasolines, Mobiloil aero engine oils and Mobil aviation special oils and greases in all States of Australia and in New Guinea, Fiji, New Caledonia and Norfolk Island. Grades of aviation petrol range from 115/154-octane to 73-octane, and aviation turbo fuel and turbine lubricating oil are also marketed. Refining is the responsibility of an affiliated company, Standard-Vacuum Refining Co., Ltd., of Altona, Victoria, who expect to have an aklylation plant to produce aviation fuel in operation by the middle of 1956.

Airport facilities range from comprehensive underground hydrant systems, capable of refuelling aircraft at 400 gal/min, at major airports to hand-operated dispensing equipment at emergency landing grounds. At Sydney, Melbourne and Nadi international airports there is round-the-clock service, and 18-hours-a-day service at the airports of all capital cities.

The company is also serving the Woomera rocket range, while another recent enterprise is the supply of products and special services to the Australasian Petroleum Co. Pty., Ltd., who are searching for oil in Papua, New Guinea, using Bell helicopters and other aircraft.

Executives include J. D. Jacobs (chairman and managing director), E. A. Jones (deputy chairman and marketing director), J. D. Rogers (director i/c aviation, Pacific Is. trade and public relations), H. B. Borwick (director i/c. industrial and Government trading), H. C. Smith (ops. director), and G. R. Brierley (financial director). Address: 29 Market Street, Melbourne.

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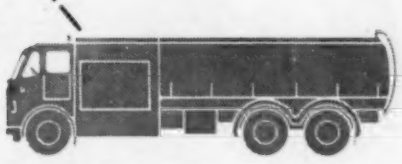

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COMMONWEALTH DIRECTORY

IN these pages are listed the majority of firms making significant contributions to the aviation industries of Australia and Canada, and which have not been described in the preceding sections of this issue. Firms already described are not repeated. This section does not claim to be a complete list of every single company with an aeronautical connection; rather is it a guide to supporting firms whose work is essential to that of the main aircraft constructors.

The value of these companies' efforts toward the development of Commonwealth aviation as a whole is obviously great—still more significant is the immense potential which they represent for an overall expansion of the industry in an emergency. At the time of going to press, we still awaited news of the activities of several companies—mainly Australian—which had been approached; this information will, we hope, be published on another occasion.

CANADA

AERO SURVEYS, LTD., Vancouver A.M.F., B.C. (hangar and laboratory at Vancouver airport).—Aerial survey work—topographic map, magnetometer, and scintillometer surveys. Affiliated with Fairchild Aerial Surveys, Inc., of Los Angeles. Have acquired, through their affiliates, Survey Aircraft, Ltd., a new high-altitude aircraft; new stereo-plotting has been added to operations. Executives include L. T. Eliel (man. dir.), F. Buckley (sales mgr.) F. J. Churko (prod. mgr.).

AEROMAGNETIC SURVEYS, LTD.—See P.S.C., Ltd., p. 301.

AIRCRAFT INDUSTRIES OF CANADA, LTD., P.O. Box 200, St. John, Quebec.—Repair, overhaul and conversion of Canso, Harvard and Dakota aircraft; repair and overhaul contracts for Department of National Defence; overhauls and conversions on executive and commercial aircraft. Executives include D. A. Thomas (chmn.), J. H. Lucas (pres. and gen. mgr.), J. F. Brown (asst. gen. mgr.).

AIRCRAFT PARTS AND SUPPLIES, REGD.—See Noorduyn Norseman Aircraft, Ltd., p. 300.

ALUMINIUM FOUNDRY AND PATTERN WORKS, LTD., 1345 Miron Street, Ville St. Laurent, Montreal, 3.—Aluminium and bronze founders, about 60 per cent of whose current production in a 15,000 sq ft plant is for the aircraft industry. Executives include W. B. Chadwick (pres.), A. Brandt (treas.), R. J. P. Dawson (sec.).

ALUMINIUM LABORATORIES, LTD.—See Aluminium Company of Canada, Ltd., p. 298.

AMERICAN CHEMICAL PAINT CO., Windsor, Ontario.—Subsidiary of a well known American company founded in 1914, this firm specializes in surface-treatment chemicals either as direct coatings or as ingredients in paints. Of special interest to the aircraft industry is "Alodine" protective coating for light alloys. Both colourless and dyed coatings are being developed. Executives include Leon Cherksey (pres.), F. P. Spruance (vice-pres.), J. H. Geyer (chief of metal-treating development).

ARO EQUIPMENT OF CANADA, LTD., 133 Wellington Street W., Toronto.—Canadian representatives of the Aro Equipment Corporation of Bryan, Ohio. Aircraft oxygen components and accessories.

ATLAS STEELS, LTD., Welland, Ontario.—Plant of 1,200,000 sq ft is devoted to the production of special steels, including high-speed, hot-work, carbon and alloy tool, die blocks, stainless and aircraft quality to ANQQS, BSS and other specifications. Suppliers of aircraft steels to the principal airframe, engine and component manufacturers in Canada, and are on British Air Ministry list as well as on those of Canadian and U.S. counterparts. Executives include R. H. Davis (pres.), E. P. Geary (vice-pres. and gen. sales mgr.), H. George De Young (vice-pres. operations), A. G. Howey (sec.).

AVIATION DEVELOPMENTS (CANADA), LTD., 2709 Yonge Street, Toronto 12.—Founded in 1941, as an extension to their then parent company, Aviation Developments, Ltd., England, in association with T. B. Martin of Toronto, the firm specializes in sales and service of products produced in the U.K. and U.S.A. These products, basically, are specialized types of fastenings and equipment, such as the Chobert blind riveting system, Avdel sheet-gripper, Pip Quick release pin, and the Huck lockbolt. Executives include S. T. Johnson (pres.), T. B. Martin (vice-pres.), K. B. Martin (sec.-treas.).

AVIATION ELECTRIC, LTD., 200 Laurentian Boulevard, Montreal 9, Quebec.—In two plants, one in Montreal and the other in Vancouver, this firm specializes in the manufacture, overhaul, repair, development and sale of aircraft accessories and instruments. The company represents a number of leading British and U.S. aircraft accessory and instrument firms. A wholly owned subsidiary in Vancouver, Aviation Electric Pacific, Ltd., was recently formed. Executives include A. Bandi (pres.), H. Wyler (vice-pres.), A. A. Macnaughton, J. M. Brian.

AVIQUIPO OF CANADA, LTD., 636 St. Paul Street, W., Montreal.—Formed in 1943 as a manufacturers' agent, this company is a branch of the New York Aviquipo organization and serves many Canadian aircraft firms. It maintains a Montreal warehouse stocking a comprehensive selection of aircraft hardware, electrical equipment, flight and engine instruments and materials, and has a sales and purchasing branch in Toronto.

B.B. CHEMICAL COMPANY OF CANADA, LTD., 2610 Bennett Avenue, P.O. Box 1447, Montreal.—Manufacturers of industrial adhesives for use in aircraft.

BABB CO. (CANADA), LTD., Montreal Airport, Dorval, St. John, Quebec.—Formed in 1946 as a subsidiary of Babb Co., Inc., a 30-year-old American organization supplying engineering products, this firm provides aircraft spares and accessories from a 40,000 sq ft warehouse. A large proportion of their work consists of the supply of accessories to another Babb subsidiary, Aircraft Industries of Canada, Ltd. (*q.v.*). Executives include Edward Lund (pres.), Cheston M. Newhall (vice-pres. and gen. mgr.), W. J. Shewan (sec.-treas.), T. D. Lord (sales mgr.).

BRITISH AMERICAN OIL CO., LTD., Toronto.—Founded in 1906, this company supplies aviation gasolines and lubricants to commercial operators and the R.C.A.F. It has refineries at Montreal East, Clarkson, Moose Jaw, Edmonton and Calgary. Executives include M. S. Beringer (chmn.), Ole Berg, Jr. (pres.), D. L. Campbell (vice-pres.).

BRITISH THOMSON-HOUSTON EXPORT CO., LTD., Toronto.—Canadian representative of the well-known English specialists in electrical equipment of all kinds.

BURNDY CANADA, LTD., Toronto (sales offices at Vancouver, Calgary, Winnipeg, Toronto, Montreal).—Specializes in the design and manufacture of electrical connectors of all types and sizes for industrial and transport applications. Executives include F. H. McLenaghan (gen. mgr.), S. G. Ward (sales mgr.).

CANADA FOUNDRIES AND FORGINGS, LTD., Brockville and Welland, Ontario.—Manufacturers of forgings for aircraft use.

CANADIAN FAIRBANKS-MORSE CO., LTD., Montreal.—Describing itself as "a national organization serving Canadian industry, through 15 branches and a factory with 1,340 employees," the company was established early in the century and now does a nation-wide business in supplying industrial and transport equipment, tools and materials. The factory is situated at Sherbrooke, P.Q., 100 miles from Montreal.

CANADIAN FLIGHT EQUIPMENT, LTD., Cobourg, Ontario.—A comparatively new concern, this company is manufacturing the Martin-Baker ejection seat and plans to extend its activities to other military-aircraft equipment. It also makes seating for civil aircraft and is to undertake sub-contract work for major Canadian constructors. Executives include R. A. J. Murison (gen. mgr.), R. S. Sheaff (qual. control mgr.), R. Cockerell (sub-contract mgr.), T. H. Bennett (prod. mgr.).

CANADIAN S.K.F. CO., LTD., Scarboro, Ontario, was founded in 1917, and new headquarters and manufacturing division in 1949. Nearly one-third of the present large plant is engaged on manufacture of precision ball and roller bearings, as used by Rolls-Royce Canada, A. V. Roe Canada and Canadian Pratt and Whitney. Executives include G. Wester (pres. and gen. mgr.), J. F. Murphy (exec. vice-pres. and sec.), G. H. Rowat (vice-pres. and gen. sales mgr.), and B. L. Haley (vice-pres. and ch. engr.).

CANNON ELECTRIC CANADA, LTD., 2451 Danforth Avenue, Toronto 13.—Incorporated in 1942 as a wholly owned subsidiary of Cannon Electric Co. of Los Angeles, manufactures complete range of electrical connectors for aircraft application. Progressive change from assembly only to complete manufacture has necessitated building of an additional new factory, in N.B. Toronto, which will shortly be ready for production. Executives include C. H. Legge (mgr.), F. L. Hancock (asst. mgr. and sec.), W. A. Bradley (plant supt.) and R. S. Shaw (engr.).

CARRIERE AND MACFEETERS, 51 Front Street E., Toronto.—Overhaul and repair of aircraft electrical accessories and telecommunications equipment. The proprietor and general manager of the firm, which has a plant at Toronto's Island Airport, is R. J. Carriere.

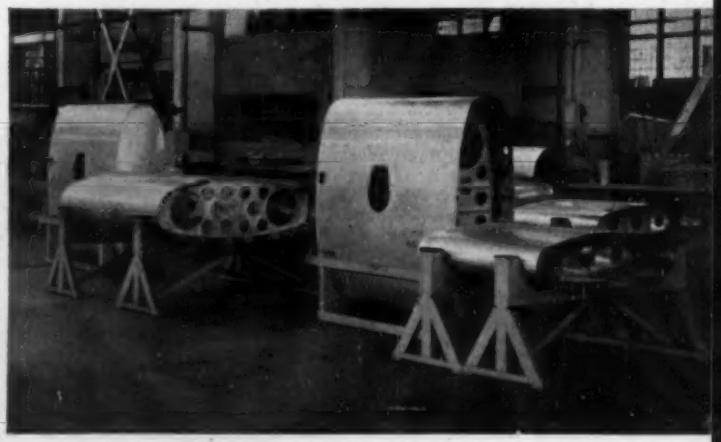
CARRUTH LABORATORIES, 94 Haddington Avenue, Toronto 12, Ontario.—Canadian sales office of Carruth Laboratories, Inc., of Dallas, Texas, manufacturers of aircraft instrument parts. Manager of Canadian office, H. Robertson.

CHATCO STEEL PRODUCTS, LTD., Tilbury, Ontario.—The aircraft side of this organization holds a sub-contract from A. V. Roe Canada for the complete mantenance and assembly of centre-sections, rear fuselage sections and fins and rudders for the CF-100 (this is stated to be the largest airframe sub-contract awarded by the constructors of the CF-100). Current plans for expansion envisage further major sub-assembly production and negotiations with British, U.S. and Canadian firms are under way. Executives include H. S. Shannon (pres.), C. L. Ketchabaw (gen. mgr. and treas.).

T. C. CHOWN, LTD., 1440 St. Catherine Street W., Montreal, and 983 Bay Street, Toronto.—Canadian representatives of the Thermix Corporation, Greenwich, Connecticut, dealing in pressure switches, float valves and similar components; also aircraft seats.

COCKSHUTT AIRCRAFT, LTD., Renfrew, Ontario.—Formed in 1951 as a subsidiary of Cockshutt Farm Equipment, Ltd., from whose aircraft division in Brantford, Ontario, manufacturing facilities were transferred in a few months without interrupting production. In modern building of 107,200 sq ft floor area, some 400 employees make gas-turbine combustion-system parts and assemblies, together with undercarriage hydraulic equipment, oil tanks, and experimental components of a security-classified nature. Canada's largest users of Inconel and Nimonic alloys, the company claims

Fuel tanks are an example of the diverse work of Enamel and Heating Products.



COMMONWEALTH DIRECTORY . . .

to have evolved outstandingly efficient methods of working these materials and to have made information available to other users. Executives include C. Gordon Cockshutt (pres.), S. S. Lee (vice-pres. and gen. mgr.), G. M. Thomson (sec.), George E. Bausor (works mgr.).

DOMINION FASTENERS, LTD., Hamilton, Ontario, are manufacturers of the various types of fasteners pioneered by the American firm of Tinnerman Products, Inc. Some of the more important standard types for the aircraft industry are the U- and J-type self-retaining Speed Nuts; cable, wire and tube retainers; instrument mounting nuts; quick-action cable-harness clamps; and self-locking hose clamps. Executives include George A. Tinnerman (pres.), W. F. Beattie (vice-pres. and gen. mgr.), and L. Wills (sec.-treas.).

DOMINION MAGNESIUM, LTD., 320 Bay Street, Toronto, are primarily producers—in their plant at Haley, Ont.—of high-purity (99·95-99·97 per cent) magnesium by the Pidgeon ferro-silicon process. Light Alloys, Ltd. (*q.v.*), are a wholly owned subsidiary.

DUNLOP TIRE AND RUBBER GOODS CO., LTD., 870 Queen Street East, Toronto 8.—Although aviation work represents only about one per cent of the output of Dunlop's Toronto factory, tyres produced for the Avro Canada CF-100's (four mainwheels and two nosewheels per machine) alone represent a considerable contract. Almost all tyre work and some "Dunlopillo" latex foam manufacture are to be transferred to the new Whitby plant, 28 miles from Toronto, when it is in full operation. Other aircraft work includes anti-icing equipment, aircraft and refuelling hose, "Dunlopillo" cushioning and moulded parts, wheels and brakes.

ELECTRO - HYDRAULICS (CANADA), LTD., 18 Ingram Drive, Box 14, Station D, Toronto.—Canadian representatives of the British Electro-Hydraulics company of Warrington. Landing gear, hydraulic systems, electro-hydraulics and powered flying controls.

ELLIOTT BROTHERS, Box 124, Sioux Lookout, Ontario.—Manufacturers of aircraft ski equipment.

ENAMEL AND HEATING PRODUCTS, LTD., Sackville, New Brunswick, are manufacturers of major airframe assemblies. Last year they tooled-up for participation in Canadair's expected T-36 production contract, and when this programme was cancelled they switched their Amherst plant to repair and overhaul of Lancaster parts, which work is continuing. The company has lately been named as co-major sub-contractors, with CanCar, to de Havilland Canada in the production of the Grumman S2-F for NATO orders. Enamel and Heating Products will be responsible for complete tail assemblies.

ENTERPRISE AGENCIES, LTD., 5301 Western Avenue, Montreal 28.—Sole Canadian representatives for Eastern Industries, Inc., New Haven, Conn., manufacturers of pressurization, dehydration and airborne cooling units; aircraft pumps; electronic-valve-cooling units. Are supplying pressurization and dehydration units to A. V. Roe Canada, Ltd., and cooling equipment to Canadair, Ltd.

FEDERAL CINE-PHOTO PRODUCTS, LTD., Queen Street, Ottawa, are sole agents in Canada for Cinematograph Export, Ltd., of London, N.W.2, England; the latter are sole distributors outside the United Kingdom for Vinten flight-test cinematographic equipment (ground and airborne).

FERRANTI ELECTRIC, LTD., Mount Dennis, Toronto, 15.—Manufacturers of transformers.

FIBERGLAS CANADA, LTD., 50 St. Clair Avenue, Toronto.—Manufacturers of Fiberglas products, insulation, sleevings, cloths, moulded parts and reinforcing materials.

FIELD AVIATION CO., LTD.—See P.S.C., Ltd., p. 301.

Inside one of the maintenance hangars of Northwest Industries, Ltd., Edmonton. In the background is a line of Dakotas for reconditioning.

FLIGHT REFUELLING (CANADA), LTD., 6910 Birnam Avenue, Montreal, 15.—Canadian representatives of Flight Refuelling, Ltd., of Tarrant Rushton Airfield, Blandford. Suppliers of the parent company's range of in-flight refuelling systems and equipment.

FOUND BROS., AVIATION, LTD., Malton, Ontario.—With a main plant and hangar at Malton airport, this company is engaged on the manufacture of temperature bulbs and of aircraft ground-handling equipment, together with the supply of reconditioned aircraft parts. Work is also being done on the development of an aircraft, the FBA 2. Executives include N. K. Found (pres.), F. M. Staines (vice-pres.), S. R. Found (sec. and treas.).

GENAIRE, LTD., Municipal Airport, St. Catharines, Ontario.—In a plant of 30,000 sq ft floor area, 175 men are employed on repair and overhaul of aircraft and electronic equipment. Contracts include repair and overhaul of airframe components for R.C.A.F. Executives include H. B. Picken, B.Sc. (pres.), G. R. Wooll (man. dir.).

GOODYEAR TIRE AND RUBBER CO. OF CANADA, LTD., New Toronto, Ontario.—Founded in 1910 as subsidiary of the parent organization of Akron, Ohio, the company are principally manufacturers of tyres and tubes, but also make valves, accessories, "Airfoam," "Pliofilm," and aircraft wheels and brakes. In another factory, at Bowmanville, Ont., are made industrial rubber products (belting, hose, packings, etc.), while moulded rubber goods are manufactured in Quebec City and a textile mill is maintained at Ste. Hyacinthe, Quebec. Aircraft products manufactured under supervision of resident R.C.A.F. inspector. Manager of aviation products department, F. C. Gilbert.

HAYES STEEL PRODUCTS, LTD., Merritton, Ontario.—Manufacture of steel and aluminium alloy forgings for landing gear and other components; machining of aircraft parts.

HEROUX MACHINE PARTS, LTD., 340 Thurber, Longueuil, Quebec.—Founded in 1939, are manufacturers of hydraulic assemblies, extruded hinges and miscellaneous aircraft parts. Overhaul of hydraulic equipment is also undertaken. Executives: Jesse Turner (pres.), Joachim Crete (vice-pres.), Edward Tighe (sec.-treas.).

HIGH DUTY ALLOYS (CANADA), LTD., 602A Royal Bank Building, 8 King Street E., Toronto, 1.—Subsidiary of High Duty Alloys, Ltd., of Slough, and a company of the Hawker Siddeley Group. See under Canadian Steel Improvement, Ltd., p. 299.

HUNTING ASSOCIATES, LTD.—See P.S.C., Ltd., 301.

HUNTING - PERCIVAL AIRCRAFT (CANADA), LTD., Municipal Airport, Oshawa, Ontario—Hunting-Percival aircraft sales and service. See also P.S.C., Ltd., p. 301.

INAERCO, LTD., 10 Sword Street, Toronto.—Originally formed in 1940 under name of International Aeronautical Corporation, the company claims to be the only purely Canadian concern in its particular field, i.e., the manufacture of high- and low-pressure hose and accessories, together with engine and airframe parts and high-precision work. Expansion into new plant at Perth, Ontario, now in hand. Executives: Ian S. Filsche (pres.), Col. S. C. Cook (vice-pres.), Miss M. F. McAuley (sec.).

INDUSTRIAL ELECTRONICS OF CANADA, LTD., 83 Torbarrie Road, Toronto 15.—Canadian subsidiary of the American firm of Servomechanisms, Inc., the company are principally concerned, in the aircraft field, with development of electronic fire-control equipment. Approx. 4,500 sq ft of the Toronto plant is devoted to the assembly and wiring of air data computors. Executives: A. S. Mackie (pres.), C. H. Hartley (vice-pres.), D. C. Stewart (sec.-treas.).

IRVING AIR CHUTE, LTD., 479 Central Avenue, Fort Erie, Ontario.—Suppliers of Irving aircraft parachutes.

IRVINGTON VARNISH AND INSULATOR CO. OF CANADA, LTD., 1390 Burlington Street, East Hamilton, Ont.—Subsidiary of Minnesota Mining and Mfg., of St. Paul, Minn., the company manufactures complete range of flexible insulating materials, insulating varnishes, and extruded plastic tubings; of particular interest to aircraft industry are extruded vinyl tubing and "class H" high-temperature electrical insulating materials. Executives include H. P. Buetow (pres.) and J. E. Williams (vice-pres. and gen. mgr.).

JARRY HYDRAULICS, 4384 St. Denis, Montreal.—Having delivered over 20,000 hydraulic assemblies for Canadair-built F-86s, the company has also established its own design department for landing-gear and hydraulic equipment. New plant facilities have recently added 15,000 sq ft to existing 30,000 sq ft. It is hoped to manufacture (under licence from Messier) undercarriage and complete hydraulic systems for Canadair-built M.R. Bristol Britannias, and negotiations are in hand for manufacture of all hydraulics for the D.H.C.-built Grumman S2-F. Jarry are North American licensees for the Pulsometer Engineering Co., Ltd., of Reading, England. Executives include Fernand Jarry (pres.), Adalbert Jarry (vice-pres.), Leo Vadeboncoeur (gen. man.), John Truran (sales mgr.), John Fullam (design project mgr.).

KENTING AVIATION, LTD.—See P.S.C., Ltd., p. 301.

WALTER KIDDE AND CO. OF CANADA, LTD., 6975 Jeanne Mance Street, Montreal 15.—The company was formed in 1928 as a subsidiary of Walter Kidde, Inc., of Belleville, N.J. In 1947 a move was made to a new factory, but by 1951 expansion of business had necessitated extensions. The present 12,000 sq ft is still not sufficient, and plans are being made for further extensions, and for the present labour force of 50 to be increased. Current aviation products include CO_2, C.B., and methyl-bromide fire extinguishers and fire-extinguishing installations; airport and test-cell fire-protection equipment; CO_2 and compressed-air cylinders; impact switches; pneumatic-actuation equipment; automatic gunchargers; oxygen equipment; aircraft compressors; auxiliary power units; and dehydration equipment. C. Kirkland McLeod is managing director.

LEAVENS BROS. AIR SERVICES, LTD., Barker Airport, Toronto.—Apart from passenger-service and flying-school operations (which are outside the scope of this directory), the company conduct aircraft, engine, airscrew and accessory overhaul and repair, and construct Fleet Canuck aircraft; they also fabricate components for D.H.C. (Beaver) and Avro Canada (CF-100). With branches at London, Windsor, and Leamington, they are further expanding their facilities for servicing aircraft throughout Canada. Executives include C. R. Leavens (pres.), R. H. Leavens (vice-pres.), C. D. Leavens (sec.), R. O. Brown (treas.).

LIGHT ALLOYS, LTD., Haley, Ont.—Situated adjacent to the plant of the parent company, Dominion Magnesium (*q.v.*), the firm operates the largest magnesium foundry in Canada. Government-financed, the foundry was designed and built in 1952 primarily for the production of Orenda gas-turbine components, and of airframe components, for A. V. Roe Canada, Ltd.

LIQUIDOMETER CORP.—1740 Cote Vertu, Ville Street, St. Laurent, Quebec.—Canadian branch of old-established (1922) U.S.A. firm specializing in—for the aircraft industry—float-type and capacitor-type gauges for all fluids, together with liquid-level control switches, and position-indicators for flaps and other movable components. Branch plant at St. John, P.Q.

Electronic testing of automatic pilots at the Toronto plant of Phoenix Engineered Products, Ltd., specialists in instrument overhauls.

MACDONALD BROS. AIRCRAFT, LTD.—See Bristol Aeroplane Engines Co. of Canada, Ltd.

MINNEAPOLIS-HONEYWELL REGULATOR CO., LTD., Leaside, Toronto 17.—Canadian factory of well-known American manufacturers of aircraft automatic control devices, whose claim it is to have produced more autopilots (40,000 produced last year) than any firm in the world, and to have developed world's first electronic autopilot. Other products include helicopter autopilots; gyros; fuel gauges, automatic fuel-control equipment and jet-pipe temperature indicators.

NORTHWEST INDUSTRIES, LTD., Aircraft Division, Box 517, Municipal Airport, Edmonton, Alberta.—In three large hangars, some 650 people are engaged on maintenance and repair of all types of aircraft and components (excluding engines). Current contracts include overhaul and modification of B-25s and C-119s for R.C.A.F., and a Canadair sub-contract for overhaul of T-33 jet trainers. Stated to be the only approved Douglas Aircraft overhaul and service centre west of Montreal and north of Los Angeles, the plant has also reconditioned numerous DC-3s and C-47s. A large new instrument laboratory is among the facilities. Executives include F. G. Winspear (pres.), B. W. Pitfield (vice-pres. and gen. mgr.), G. L. Best (mgr., a/c divn.), and R. Whitaker (sec.-treas.).

PHOENIX ENGINEERED PRODUCTS, LTD., 750 Lawrence Avenue West, Toronto.—With an impressive war record in the production of aircraft instruments and fuel pumps, the company is now engaged, in a plant of 71,000 sq ft floor area, in the major overhaul and test of some 500 types of instruments. In the case of obsolescent instruments for which replacement parts are impossible to obtain, Phoenix have the necessary knowledge and facilities to make the details themselves. Special equipment is maintained for the testing of gyro gunsights and electronic autopilots.

PHOTOGRAPHIC SURVEYS (QUEBEC), LTD., and **(WESTERN), LTD.**—See P.S.C., Ltd., p. 301.

PRECISION RUBBER PRODUCTS (CANADA), LTD., Ste Thérèse de Blainville, Quebec.—Wholly Canadian subsidiary, founded January 1953, of Precision Rubber Products Corp., Dayton, Ohio. Approx. 14,000 sq ft of plant space devoted to production, for aircraft industry, of Precision "O" rings and Dyna-seals.

PRENCO PROGRESS AND ENGINEERING CORP., LTD., 72-74 Stafford Street, Toronto.—Company founded in 1940 by J. K. Chmel, who had previously owned a factory in Prague, Czechoslovakia, devoted to the production of aircraft hydraulics and structural applications of magnesium. During the war Prenco supplied flexible hoselines (with detachable fittings) self-sealing couplings and hydraulic control components for British aircraft. Prenco hoses are made under licence from the U.S. firm of Aeroquip, and are supplied to the R.C.A.F. and the Australian, New Zealand and Indian Air Forces. A factory extension will shortly be completed for the production of spheroid-type valves for aircraft. Executives include J. K. Chmel (pres. and man. dir.), Clifford Salton (vice-pres.), Mrs. A. Schmocker (vice-pres.), L. E. Buckwell (aircraft sales), F. Walter (designer) and A. N. Turner (ch. inspr.).

P. S. C. APPLIED RESEARCH, LTD.—See P.S.C., Ltd., p. 301.

RENOLD - COVENTRY, LTD., 1006 Mountain Street, Montreal.—Suppliers of aircraft parts, units and accessories.

E. ROY INDUSTRIES, LTD. L'Assomption, Quebec.—Established in 1889, the company are large-scale manufacturers of domestic appliances, and now have an aircraft division making airframe and engine assemblies; current contracts are for T-33 rear fuselages and for machined parts for Rolls-Royce Nene. Executives include Edouard Roy (pres.), T. Z. St. Laurent (gen. mgr.).

SANDERSON AIRCRAFT, LTD., Malton, Ontario.—Overhaul, modification and repair of aircraft, engines and radio; components and assemblies. A current sub-contract is for D. H. C. Beaver components. Executives: W. J. Sanderson (pres. and gen. mgr.).

SHELL OIL COMPANY OF CANADA, LTD., Metropolitan Building, 25 Adelaide Street E., Toronto, Ontario.—This company began operations in eastern Canada in 1912, and in British Columbia in 1913. The Montreal refinery, which was built in 1932, has a present refining capacity of 2.2 million tons per year. There is also at Montreal an associated petro-chemical plant which was the first to be established in Canada. The Shellburn refinery at Vancouver was built in 1932, and its present capacity is ¾ million tons per year. At Jumping Pound, Alberta, the company has a gas-treating plant and sulphur extraction unit. A complete refuelling service is maintained at seven Canadian airports, including Gander: during 1953 the company serviced 4,848 aircraft. W. M. V. Ash is president.

SMITH AND STONE, LTD., 50 St. Clair Avenue West, Toronto.—Manufacturers of polyester/Fiberglas laminated aircraft seats, silicone gaskets, phenolic mouldings, etc. Parent and associated company plants, located at Oshawa, Windsor, Sarnia, Guelph and Dunville produce plastic components by injection, extrusion, lamination, etc.; safety glass of all types; mirrors and graticules; porcelain and metal fittings in the electrical field; and Fiberglas insulation and insulating products. Executives include Col. W. E. Phillips (pres.), Brig. F. C. Wallace (exec. vice-pres.).

SNAP-ON TOOLS OF CANADA, LTD., 41 Cranfield Road, Toronto, are specialists in mechanics' handtools. Executives include J. Johnson (pres.), R. Palmer (vice-pres.), W. Seidemann (vice-pres.), W. H. Shearin (camptr. and sec.), A. W. Clark (gen. mgr.).

Part of the aircraft hose assembly department of the Prenco Progress and Engineering Corporation, Toronto.

SURVEY AIRCRAFT, LTD.—See under Aerial Surveys, Ltd.

TECALEMIT (CANADA), LTD., 43 King Street, Toronto, a subsidiary of the well known Plymouth, Devon, company, was formed in 1949 and in 1953 moved into larger premises to keep pace with the increasing demand for Tecalemit products in the field of specialized lubrication equipment. The oil-filter side of the company's business also quickly expanded, and a manufacturing unit, patterned on that of the English parent company, was established in 1950. A production plant for other Tecalemit equipment is now being planned. President of the Canadian company is J. F. Parker.

TIMKEN ROLLER BEARING SERVICE AND SALES, LTD., 43 Edward Street, Toronto.—Canadian sales and service representatives for the British Timken company of Birmingham. Roller bearings for aircraft.

TUBE BENDERS AND FABRICATORS, LTD., Streetsville, Toronto.—This recently established company is engaged in work of the character indicated by its title. Though the automobile and a number of other industries are served, the bulk of its production is for aircraft firms. J. A. H. Brocklebank is managing director.

VICTORY TOOL AND MACHINE CO., LTD., 236-250 Rose de Lima, Montreal 30.—Established in 1914, the company has some 30,000 sq ft of its plant, and 120 men, engaged on the manufacture of precision parts for airframes and engines.

YORK GEARS, LTD., Toronto, Specialists in the production of complicated assemblies, gearboxes, and individual parts for the aircraft industry, were founded in 1950 as a division of Canadian Acme Screw and Gear, Ltd. Now a separate company, it is housed in a new building occupying approximately 120,000 sq ft with another 800,000 sq ft of ground available for expansion. Some 700 employees are now employed in the manufacture of gearboxes for the Orenda and CF-100. Other components include power take-off drives, pumps, tachometers, etc., for the CF-100 and F-86. Considerable use is made of magnesium in castings for gearboxes.

AUSTRALIA

A.P.I. CABLES AND INSULATION PTY., LTD., 571 Bourke Street, Melbourne—Manufacturers of electric cables for aircraft.

G. ADAMS AND SON, Mascot, N.S.W. — Aircraft components; manufacture and repair of wooden airscrews.

W. O. AND B. ADAMS, Carlton, Vic.—Manufacturers of cast phosphor-bronze bar for the aircraft industry.

ADASTRA AIRWAYS PTY., LTD., 41-43 Vickers Avenue, Mascot, N.S.W.—Founded in 1930 as a flying school, Adastra developed passenger services and then, in 1936, concentrated entirely on aerial survey work. Today, with two hangars and a photographic laboratory at Kingsford Smith Airport, Mascot, Sydney, the company operate a fleet of aircraft—mainly Hudsons—on photographic survey and the production of mosaic and contour maps. They are contractors to the Federal Commonwealth Government, the State Governments of Queensland, New South Wales and Victoria, and the Snowy Mountains Hydro-Electric Authority, etc.; they also serve the Government of Fiji, and have carried out numerous contracts in New Guinea. An important new contract, in collaboration with the Hunting Group, is for a geophysical survey, using the magnetometer technique, for oil and uranium in Australia's north. Executives include G/C. H. T. Hammond, O.B.E. (gen. mgr. and dir.), L. B. Pares (asst. mgr.), Miss M. Murrell (sec.), E. Haynes (wks. mgr.).

ADVANX TYRE AND RUBBER CO. PTY., LTD., Rushcutters Bay, N.S.W.—Specialists in rubber components for aircraft.

AERIAL AGRICULTURAL PTY., LTD., Bankstown Airport, N.S.W.—Airframe and component repairs and overhauls; distributors of spares.

AERONAUTICAL SUPPLY CO. PTY., LTD., 210 Victoria Street, Melbourne, Victoria.—Manufacturers of aircraft mechanical assemblies, machined parts, sheet-metal components, etc.; distributors of spares.

AERO SERVICE PTY., LTD., Maylands Airfield, W.A.—Manufacturers of metal and wooden aircraft components; overhaul and repair of airframes, engines and components; electrical installation and overhaul.

AFTERDARK PTY., LTD., 678-684 Victoria Street, North Melbourne, Victoria.—Founded in 1943, the company has two factories, in one of which aircraft instrument-dials, panels, nameplates, etc., are manufactured; in the other, dials are luminized with radio-active and other luminous pigments. The company (which is a contractor to R.A.A.F. and aircraft manufacturers) is under the direction of C. P. Trowbridge.

ALLISON GRAY AND CO.—See Paul and Gray Pty., Ltd.

N. V. APPLETON PTY., LTD., Hendra, Queensland.—Manufacture and repair of plastic components for aircraft.

ASSOCIATED POWER SEALS PTY., LTD., 200 Bay Street, Port Melbourne, Vic.—Specialists in gaskets, oil seals, etc., for the aircraft industry.

AUSTRAL BRONZE CO. PTY., LTD., O'Riordan Street, Alexandria, N.S.W., and Williamson Road, Maribyrnong, Vic., are manufacturers of aluminium bronze, bronze bars, sheet copper, and extrusions in these materials.

AUSTRALIAN ALUMINIUM CO. PTY., LTD., Unwin Street, Granville, N.S.W.—Producers of aluminium and its alloys in many forms, e.g., ingots, forgings, rod, bar, extruded sections, sheet, strip, etc.

AVIATION AND ENGINEERING SUPPLIES PTY., LTD., 134 Ferrars Street, South Melbourne, Vic., are general distributors of aircraft spares.

AVIATION MANUFACTURING CO. PTY., LTD., Auburn, Vic., are manufacturers and distributors of "B.G." sparking plugs and fittings.

BALM PTY., LTD.—See Imperial Chemical Industries of Australia and New Zealand, Ltd.

BENDIX-TECNICO PTY., LTD., 53 Carrington Road, Marrickville, N.S.W.—In a 27,000 sq ft plant, the company employs 150 on the manufacture of aircraft electrical equipment (starters, generators, electronic amplifiers, etc.) and servicing of electrical, hydraulic and fuel-handling equipment, together with radio-compasses, oxygen regulators, etc. Principal current contracts are for manufacture of Bendix (U.S.A.) 375-amp, 30-volt aircraft generators and complete control equipment; airborne isolation and cockpit amplifiers; and AN-type Scintilla-designed connectors. Land has been acquired near Sydney for a new 40,000 sq ft factory in which, in particular, manufacture of electronic equipment will be expanded. Executives include C. A. Fordham (mgr.), W. Whitburn (prod. supt.), A. J. Coghlan (ch. engr.), V. Watts (ch. inspr.).

BRICO (AUSTRALIA) PTY., LTD., 41-57 Mallett Street, Camperdown, N.S.W.—A wholly owned subsidiary of the British group of (principally) piston and ring manufacturers known as Associated Engineering Holdings, Ltd. A mechanized grey-iron foundry, with centrifugal-casting section, is maintained, and a second plant is devoted to the machining of pistons, rings and liners. During the war the company produced aircraft piston rings to approved specifications, together with non-ferrous castings for airscrew-blade bushes. Aircraft work is at present on a small scale, but Merlin piston-rings are being produced under A.I.D. approval to cover local overhaul requirements. Execu-

COMMONWEALTH DIRECTORY . . .

tives include J. A. Judd (mg. dir.), R. M. Farthing (wks. mgr.), D. W. McDowell (sec.), and K. R. Jackson (sales mgr.).

BRITISH AUSTRALIAN LEAD MANUFACTURERS PTY., LTD., Sydney.—Manufacturers of aircraft finishes.

BRITISH TUBE MILLS (AUSTRALIA) PTY., LTD., Churchill Road, Kilburn, S.A.—Manufacturers of aircraft steel tubing, tubular components, gas cylinders, etc.; repair and overhaul of tubular structures.

BRUNTSONS BRIGHT STEEL PTY., LTD.—Booker Street, Spotswood, Vic.—Steel bar to aircraft specifications.

CABLE MAKERS AUSTRALIA PTY., LTD., Liverpool, N.S.W., are approved manufacturers of aircraft electric cables.

CASCO ADHESIVES PTY., LTD., Brunswick, Vic.—Makers of casein cement.

CHRYSLER (AUSTRALIA), LTD., Finsbury, South Australia.—Manufacture of pressed parts and sub-assemblies, under sub-contract to the Government Aircraft Factory.

COMMONWEALTH STEEL CO., LTD., Waratah, N.S.W.—Manufacturers of steel to aircraft specifications.

G. E. CRANE AND SONS PTY., LTD., Sydney, N.S.W.—Manufacturers of sheet aluminium and alloys to aircraft specifications.

DUNLOP RUBBER, AUSTRALIA, LTD., 108 Flinders Street, Melbourne, Victoria.—Established in 1903, this company formed its aviation division five years ago. Of the three factories, the aviation division operates one at Bayswater, Victoria, in which approximately 100 workpeople are employed on the production and overhaul of wheels, brakes, pneumatic equipment, flexible pipes and flexible rubber tanks (tyres, tubes and other rubber products are manufactured in the Montague, Melbourne, and Drummoyne, Sydney, factories). Wheels and brakes are currently being supplied for Canberra, Winjeel and Jindivik, and pneumatics for the Jindivik. E. R. Blackwood is general manager of the company and E. F. Faggetter manager of the aviation division.

EXIDE BATTERIES OF AUSTRALIA, LTD., 44 Bridge Street, Sydney, N.S.W.—Supply of Exide aircraft batteries; provision of battery parts; overhaul and repair.

FAWCETT AVIATION PTY., LTD., Bankstown Airport, N.S.W.—Airframe and engine overhaul and repair; overhaul of components; electrical installations and overhauls; manufacture of machined parts.

FIBRAK (AUSTRALIA) PTY., LTD., Sydney, N.S.W.—Formed last year, this subsidiary of Oldham and Sons, Ltd., the well-known battery manufacturers of Denton, Manchester, produces "Fibrak" separates for the Australian battery industry.

SIR GEORGE GODFREY AND PARTNERS (AUSTRALIA) PTY., LTD., 539 Bourke Street, Melbourne, C.1.—Subsidiary company of Sir George Godfrey and Partners, Hanworth, Middlesex, responsible for sales, servicing, maintenance and testing of the parent firm's products (cabin pressurization and air-conditioning equipment, refrigeration units, etc.) in Australia and Asia. Manufacturing facilities are planned for the future.

HAWKER SIDDELEY GROUP, 241 Williams Street, Melbourne, C.1.—Australian office of the Group, representing all the member-firms. The manager is C. J. Wood.

HENDERSONS FEDERAL SPRING WORKS PTY., LTD., Alfred Place, North Melbourne, Victoria.—As part of its general production, this company supplies a wide variety of springs, plates and other small parts for aircraft.

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C. HUPPERT AND CO., LTD., 193 Bouverie Street, Carlton, Vic.—Manufacturers of aircraft fuel, hydraulic and other pumps and associated equipment; manufacturers, under licence, of Pesco pumps; manufacturers of steel and light-alloy castings, and sub-assemblies.

KEEFER BROS. PTY., LTD., Martin Street, Beaumaris, Vic.—Makers of machined parts and sheet-metal pressings.

KINGSFORD SMITH AVIATION SERVICE, Bankstown Airport, N.S.W.—Overhaul and repair of airframes, engines and components; manufacture of components, welded assemblies, etc.

LEWIS BERGER AND SONS (AUSTRALIA) PTY., LTD., Rhodes, Sydney, N.S.W., in association with the British company of similar name, are manufacturers of aircraft dopes and finishes.

LIGHT AIRCRAFT PTY., LTD., 14 City Road, Sydney, N.S.W.—Specialists in parachutes, seat harness, safety-belts, etc.

MacROBERTSON MILLER AVIATION CO., LTD., Perth, W.A.—Manufacturers of aircraft components; overhaul, repair and maintenance of airframes, engines and airscrews; repair and distribution of fuel pumps, instruments and other accessories.

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NATIONAL FORGE PTY., LTD.—See Australian Forge and Engineering Pty., Ltd.

NATIONAL INSTRUMENT CO., PTY., LTD., Essendon Aerodrome, Vic., are sales and servicing agents for a number of British companies, including Plessey, Pullin, Schermuly and Sperry.

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NEW SOUTH WALES RAILWAYS, Chullora, N.S.W.—Manufacture of sundry detail parts, and sub-assemblies, for the Australian Government Aircraft Factory.

OLYMPIC CABLES, LTD., North Footscray, Vic.—Approved manufacturers of electric cables and polyvinyl chloride tubing for aircraft.

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PAUL AND GRAY PTY., LTD., Merchandise Division, 82-84 Sussex Street, Sydney.—This old-established (1863) concern, with offices and warehouses in the leading business centres of Australia, formed an aircraft department in 1935. During the war this department supplied, and also manufactured, small parts and sub-assemblies for the Government aircraft programme, and today its warehouse has facilities for the inspection and supply of components, accessories, standard parts, raw materials, etc. Plans are in hand to extend this service to the whole South Pacific and S.E. Asia area. An associate company is Allison Gray and Co., 82-84 Sussex Street, Sydney, Australian representatives for many leading overseas aviation companies. Paul and Gray executives include R. E. Purves (chmn.), K. O. Humphreys, A. H. Newton (gen. mgr.).

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RUSSELL MFG. CO. PTY., LTD., 81 Burnley Street, Richmond, Vic.—Makers of piston rings and other parts for the aircraft industry.

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SIMMONDS AEROCESSORIES (PTY.), LTD., 357 Exhibition Street, Melbourne.—Manufacturers and distributors of a wide range of aircraft accessories. The Board includes J. R. Burt (chairman), C. W. O. Rosier (managing director).

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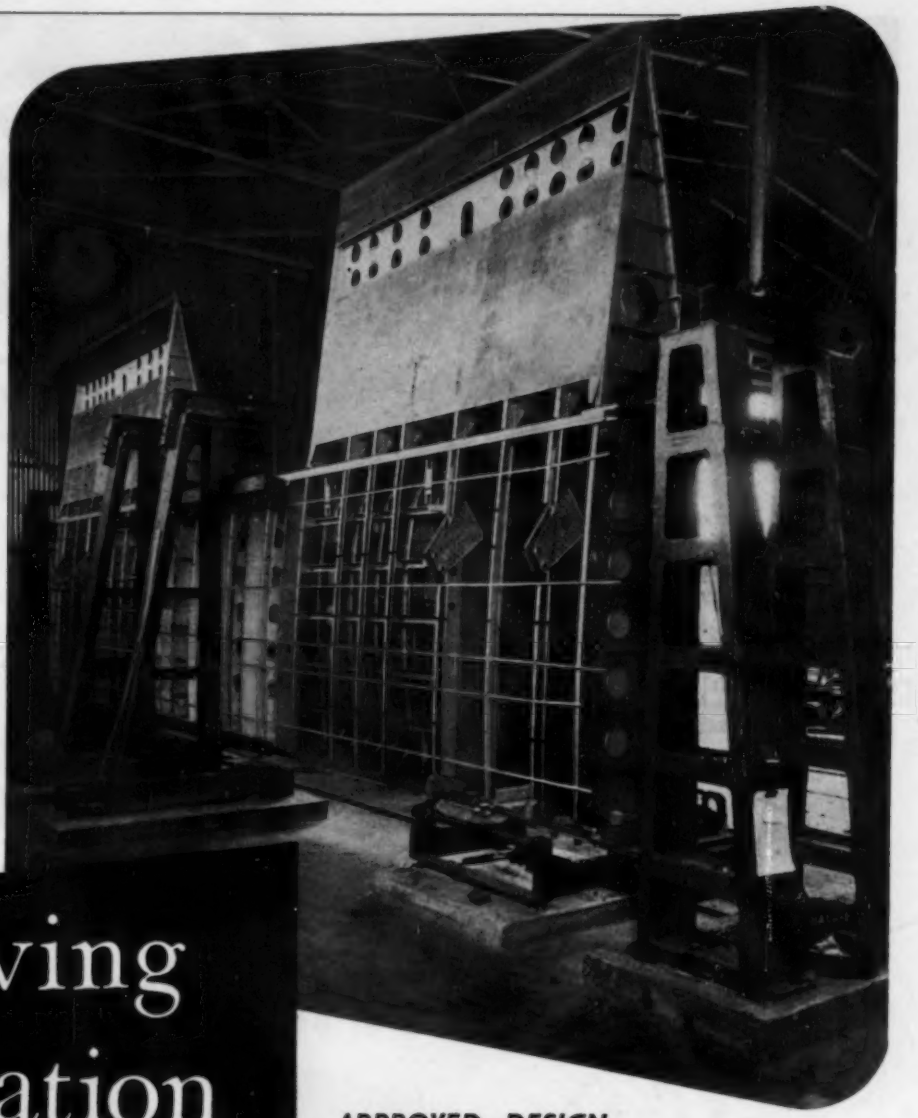
A view of the hangars and office blocks at Kingsford Smith Airport, Mascot, Sydney. The hangars of Adastra Airways are those in the left foreground, and second in the second row.



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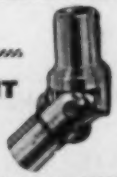

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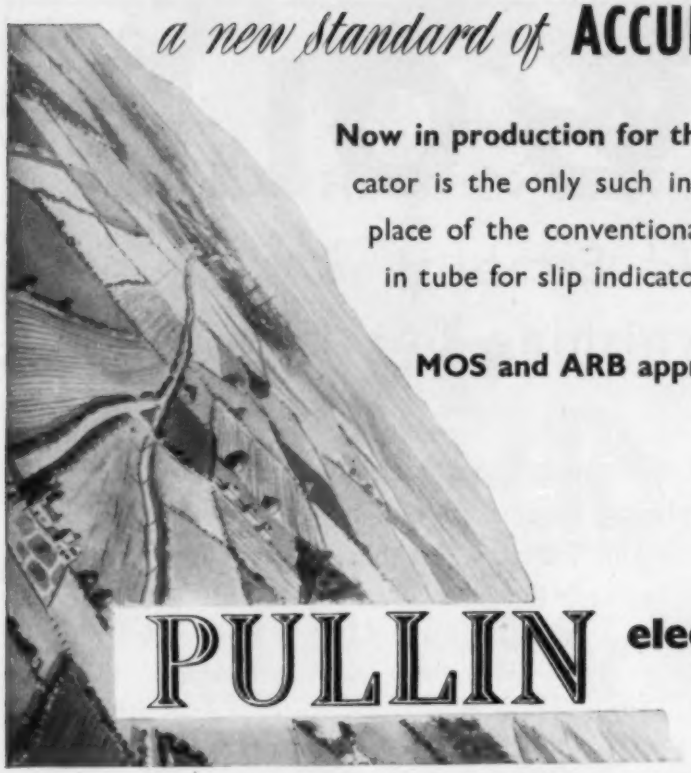

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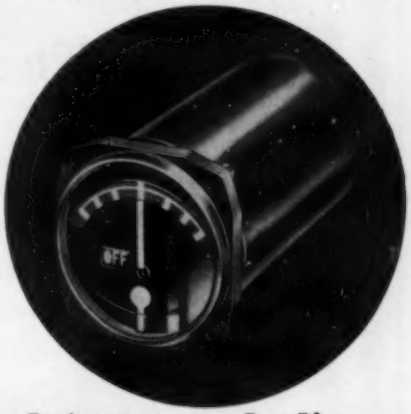

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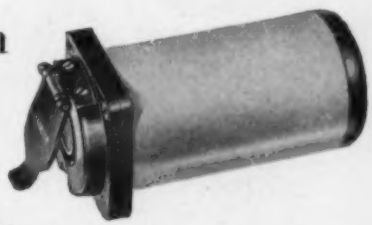

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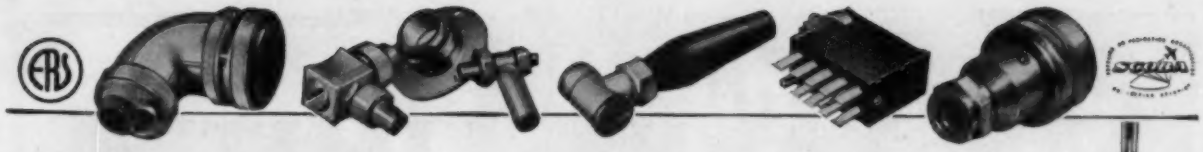

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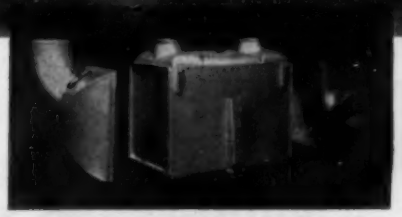

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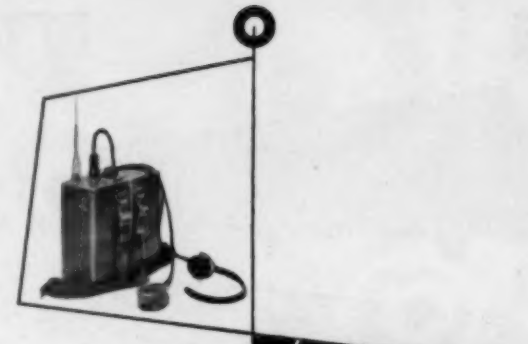

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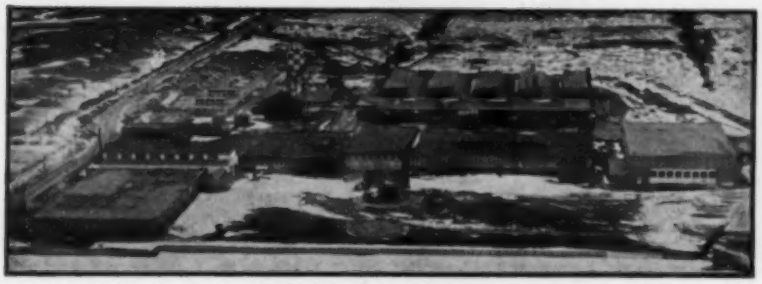

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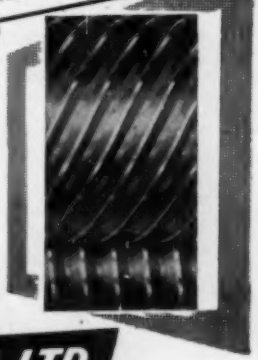

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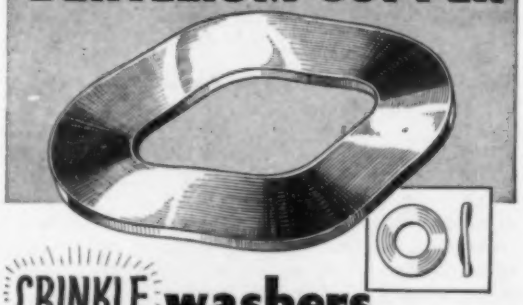

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AIR TRANSPORT ADVISORY COUNCIL

THE Air Transport Advisory Council give notice that they have received the undermentioned applications to operate scheduled air services:—

APPLICATION No. 64/1 from Airwork, Ltd., of 15 Chesterfield St., London W.1, for permission to include a traffic stop at Takoradi on their Colonial Coach service on the route London (Blackbushe)-Bathurst-Freetown and Accra, already approved by the Minister of Transport and Civil Aviation for operation until March 31st, 1957.

APPLICATION No. 20/1 from Hunting-Clan Air Transport, Ltd., of 5 Fitzhardinge St., Portman Sq., London W.1, for permission to include a traffic stop at Takoradi on their Colonial Coach service on the route London (Bovingdon)-Bathurst-Freetown and Accra, already approved by the Minister of Transport and Civil Aviation for operation until March 31st, 1957.

FROM Airwork, Ltd., of 15 Chesterfield Street, London W.1:—

APPLICATION No. 322 for a normal scheduled service initially with Hermes aircraft and later with Viscount and Bristol/Britannia aircraft, for the carriage of passengers, supplementary freight and mail, between London Airport and Abadan, with intermediate traffic stops at Geneva, Rome and Nicosia at an initial frequency of two services weekly, increasing according to traffic demand, for a period of ten years, commencing two months after date of approval.

APPLICATION No. 323 for a normal scheduled service, with Viking and Hermes aircraft, for the carriage of passengers, supplementary freight and mail, between London Airport and Fayid, with an intermediate traffic stop at Malta (night stop), at a frequency of one service weekly, increasing according to traffic demand, for a period of ten years, commencing two months after date of approval.

APPLICATION No. 327 for a seasonal vehicle ferry service with Bristol 170 aircraft, for the carriage of vehicles, passengers and freight between Birmingham (Elmdon) and Le Touquet, at a frequency of from one to three services daily, increasing according to traffic demand, during the season from May to October inclusive, for a period of ten years, commencing May 1st, 1955.

APPLICATION No. 328 for a seasonal vehicle ferry service with Bristol 170 aircraft for the carriage of vehicles, passengers and freight between Birmingham (Elmdon) and Cherbourg (Malpertus), at a frequency of from one to three services daily, increasing according to traffic demand, during the season from May to October inclusive, for a period of ten years, commencing May 1st, 1955.

FROM B.K.S. Air Transport, Ltd., of Dorset House, Old Burlington St., London W.1:—

APPLICATION No. 324 for a seasonal normal scheduled service with Dakota aircraft, for the carriage of passengers, supplementary freight and mail, between Newcastle and/or West Hartlepool and Knocke Le Zoute and/or Ostend, at a frequency of from one to 14 services weekly, during the season from April to October inclusive, for a period of seven years, commencing May 1st. 1955.

APPLICATION No. 325 for a seasonal normal scheduled service with Dakota aircraft, for the carriage of passengers, supplementary freight and mail, between Southend and Knocke Le Zoute and/or Ostend, at a frequency of from one to 14 services weekly, during the season from April to October inclusive, for a period of seven years, commencing May 1st, 1955.

APPLICATION No. 288/1 from Air Charter, Ltd., of 15 Great Cumberland Place, London W.1, for an amendment to their vehicle ferry service on the route Southend-Calais (Application No. 288), which has recently been approved by the Minister of Transport and Civil Aviation, to enable the service to terminate at Le Touquet instead of at Calais in the event of the Airport at Calais being closed between October 15th, 1954, and April 30th, 1955.

APPLICATION No. 326 from Starways, Ltd., of Speke Airport, Liverpool, for a seasonal inclusive tour service, in conjunction with Cathedral Touring Agency, Ltd., with Dakota aircraft, for the carriage of passengers between Belfast and Tarbes (for Lourdes), at a frequency of from one service fortnightly to three services weekly, during the season from May to October inclusive, for a period of ten years, commencing May 1st, 1955.

THESE applications will be considered by the Council under the Terms of Reference issued to them by the Minister of Civil Aviation on July 30th, 1952. Any representations or objections with regard to these applications must be made in writing stating the reasons and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 3 Dean's Yard, London S.W.1, from whom further details of the applications may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, should reach them within the period allowed for the making of representations or objections.

THE Air Transport Advisory Council also give notice that the following application has now been withdrawn:—

APPLICATION No. 315 from Starways, Ltd., of Speke Airport, Liverpool, for a normal scheduled service between Liverpool-London Airport and Paris, with Dakota aircraft, which was advertised in "The Times," "The Aeroplane" and "Flight," on July 30th, 1954. [2491

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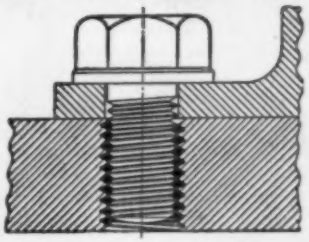

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SITUATIONS VACANT

The engagement of persons answering these advertisements must be made through the local office of the Ministry of Labour and National Service, etc., if the applicant is a man aged 18-64 or a woman aged 18-59 inclusive, unless he or she or the employer is excepted from the provisions of The Notification of Vacancies Order 1952.

APPLICATIONS are invited for the following permanent and progressive positions:—

Mechanical Fitters.

Knowledge of electrics. (Ref. 13.)

Planning and Mechanical Engineer.

Design of rigs and fixtures, heating inductors. To assist in planning of operations. O.N.C. with factory experience or H.N.C. standard. Candidates must have completed National Service. (Ref. 14.)

CANDIDATES for the above two positions will be required to work at Hatfield initially, but final employment will be at Edmonton.

Electronic and Electrical Engineers

for development work on servo mechanisms. (Ref. 44.)

Wiremen,

electronic, for model shop development work. (Ref. 12.)

Circuit Engineer.

Previous experience and knowledge of electronics essential. (Ref. 41.)

Instrument Mechanic

with electrical instrument experience for vibration research. O.N.C. or H.N.C. standard. Staff appointment. (Ref. 42.)

Draughtsman,

jig and tool. Salary according to age and experience. (Ref. 11.)

WRITE in detail, quoting reference number of position sought, to the Personnel Department (Technical Employment), de Havilland Propellers, Ltd., Hatfield, Herts. [2464

Guided Missiles Division
of
THE ENGLISH ELECTRIC CO., LTD.,
at Luton,
require the following technical staff:—

(A) **SENIOR MECHANICAL DESIGNER** for the Propulsion Drawing Office, to take charge of a group of draughtsmen engaged on the mechanical design of solid-fuel sustainer motors. Qualifications: H.N.C., experience on pressure vessel design, aeronautical background an advantage. Ref. 1261B.

(B) **SENIOR DESIGN** and **DEVELOPMENT ENGINEERS** in the following categories:—
(1) Servomechanisms for control systems.
(2) Light electrical engineering for the development of light electrical equipment.
(3) Project designers and assistant project designers both electrical and mechanical.
(4) Test equipment engineer for the development of special electrical and hydraulic test equipment.
(5) Hydraulic designers for design and development of hydraulic valves in servo control systems.
Preferably not less than 30 years of age, with experience in the appropriate fields, and in the handling of staff, and a minimum H.N.C. academic standard. Ref. 1325B.

HOUSING assistance may be possible to suitable successful applicants.—Apply, with full particulars of age, qualifications, etc., and quoting relevant reference number, to Dept. C.B.S., 336/7 Strand, W.C.2. [2448

SMALL progressive firm near London, dealing in Aircraft and Aircraft Components, require energetic male to handle sales. Please write, stating qualifications and experience to Box 7329. [2473

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Also vacancies for **"A" and "C" Licensed Engineers** with coverage on Rapide, Consul and Dakota aircraft at Eastleigh, Southampton, Airport, and **experienced Radio Engineers** at Blackbushe.

Applications in writing, giving full details of qualifications and experience to Personnel Officer, Ferry Airports Ltd., Blackbushe Airport, Camberley, Surrey.

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Please write, giving details, to:

Personnel Manager,
Dunlop Rubber Co. Ltd.,
Aviation Division,
Holbrook Lane,
Foleshill, Coventry

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Applications should be made to the **Employment Manager, Vickers-Armstrongs Ltd., Weybridge Works, Weybridge, Surrey.**

SITUATIONS VACANT

CHIEF technical instructor required for service at the Indian Air Force Technical Training College, Bangalore, South India. Duties will include the teaching of at least one of the following subjects to degree standard:—

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(3) METALLURGY
(4) EXPLOSIVES AND BALLISTICS

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THE period of service is for two years, plus one further year at the option of the employer. Salary: Rs. 2,400 per month, plus annual sterling gratuity of £360. Total sterling equivalent approximately £2,500 per annum.

APPLY to The Commandant, Air Service Training, Ltd., Hamble, Southampton. [2471

ENGLISH ELECTRIC

Guided Weapons Division

invite applications for the post of

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THIS post demands high technical qualifications, together with administrative ability of a high order. The appointment commands a salary commensurate with the experience and qualifications of the successful applicant, who will be provided with housing assistance.

APPLICATIONS, giving full particulars of previous experience, should be addressed to Ref. 1355A, Dept. C.P.S., 336/7 Strand, W.C.2. [2475

FLIGHT TEST ENGINEER

SMITHS AIRCRAFT INSTRUMENTS, Ltd., have a vacancy for a flight test engineer with their Development Flight operating from Staverton, Glos. This flight is chiefly concerned with the development of automatic pilots and navigational systems. Applicants should be conversant with this field and have had experience with the planning of experimental flying, the devising and installation of apparatus for automatic and visual observation and the interpretation of results.—Applications should include full particulars of past experience and be addressed to the Personnel Manager, Smiths Aircraft Instruments, Ltd., Bishops Cleeve, nr. Cheltenham, Glos. [2445

RADIO officers required by the

EAST AFRICA HIGH COMMISSION DIRECTORATE OF CIVIL AVIATION for one tour of 30 to 48 months in the first instance, with prospect of permanency. Salary scale (including present temporary allowance of 35 per cent. of salary), £742, rising to £965 a year. Gratuity of 13½ per cent. of total basic salary drawn during contract for those not taken on permanent establishment. Free passages. Liberal leave on full salary. Outfit allowance, £30. Candidates must be capable of operating at 25 w.p.m., and should preferably hold M.C.A. 1st Class Certificate in radio telegraphy. Knowledge of touch typing for teleprinter, the operation of modern radio or radar aids, or experience in radio maintenance would be an advantage.—Write to the Crown Agents, 4 Millbank, London S.W.1. State age, name in block letters, full qualifications and experience, and quote M2C/30606/FE. [2470

ASSISTANT signals officer required by the

SIERRA LEONE GOVERNMENT CIVIL AVIATION DEPARTMENT for one tour of 18-24 months, with prospect of permanency. Salary scale (including expatriation pay), £742 rising to £1,177 a year. Outfit allowance, £60. Liberal leave on full salary. Free passages for officer and wife. Assistance towards cost of children's passages or grant up to £150 annually for maintenance in U.K. Candidates should be experienced in m.f., h.f., v.h.f. and v.h.f./d.f., and ancillary equipment, and should hold the P.M.G. Certificate in Wireless Telegraphy or equivalent.—Write to the Crown Agents, 4 Millbank, London S.W.1. State age, name in block letters, full qualifications and experience, and quote M2C/30353/FE. [2460

TECHNICIANS, Grade I (Radio) required by

EAST AFRICAN POSTS AND TELECOMS ADMINISTRATION on probation for pensionable employment. Salary scale (including present temporary allowance of 35 per cent. of salary), £742 rising to £1,134 a year. Outfit allowance, £30. Free passages. Liberal leave on full salary. Normal tour, 4 years. Candidates should possess a thorough practical knowledge of the working and maintenance of modern h.f. radio telegraph equipment and v.h.f. multi-channel radio-telephone equipment. G.P.O. staff should apply through departmental channels.—Write to the Crown Agents, 4 Millbank, London S.W.1. State age, name in block letters, full qualifications and experience, and quote M2C/32424/FE. [2469

A. J. W. (INSTRUMENTS), Ltd. Vacancies for experienced instrument mechanics. Interesting and varied work on automatic pilots, gyro, electric and physical instruments.—Apply to: A. J. W. (Instruments), Ltd., Gatwick Airport, Horley, Surrey. [0270

SITUATIONS VACANT

D. NAPIER AND SON, Ltd., Luton Airport, urgently require:

SENIOR technical assistants for interesting research and development work on aircraft de-icing and ice-detection devices. Degree standard desired and familiarity with aircraft an advantage. Some junior posts also available.—Apply with full particulars to Dept. C.P.S., 336/7 Strand, W.C.2, quoting Ref. 1309A. [2472

SMITHS AIRCRAFT INSTRUMENTS, Ltd., require an aircraft maintenance engineer for work in the company's Development Flight (Staverton Airport). PREFERENCE will be given to applicants holding licences endorsed in airframe/engine categories for Dakota and Anson. Salary according to qualifications and experience.—Apply in first instance to Personnel Manager, Smiths Aircraft Instruments, Ltd., Bishops Cleeve, Glos, quoting reference 32/EN. [2446

STOREMAN required for small progressive firm near London. Must be conversant with aircraft spares.—Please write, stating experience, to Box 7330. [2474

AIRCRAFT RATEFIXERS required, experienced in fuselage and wing assembly. Write, giving full particulars to Personnel Dept., Vickers-Armstrongs Ltd., Supermarine Works, Woolston, Southampton. [2458

LICENSED engineer required for aircraft overhaul work. Minimum qualifications A groups 5.1 and 5.2. C groups 6.1.—Apply by letter to Aerocontacts, Ltd., Gatwick Airport, Horley, Surrey. [2487

V.H.F./D.F. operator (experienced) required.—Applications, giving full particulars of qualifications, age and experience to Chief Clerk, The College of Aeronautics, Cranfield, Bletchley, Bucks. [2480

LICENSED ground engineer wanted for club and private aircraft maintenance on the south coast. "A" and "C" licences required on Messenger, Magister, Gemini and Aerovan.—Box 5830. [0345

LICENSED engineer covering Doves, Rapides, Austers. Permanent position.—Apply in writing to East Anglian Flying Services, Ltd., Southend Airport, Essex. [2478

NAIROBI. Licensed aircraft engineers required.—Write in first instance, with full details past experience, age, etc., to Agents, Adie Aviation, Ltd., Croydon Airport, Croydon, Surrey. [2463

U.K. air transport company would like to receive applications in confidence from the following grades, stating rate of pay required: "X" licensed electrical engineers, "A" licensed radio engineers and radio mechanics.—Box 7145. [2442

AIRCRAFT inspectors required for major assemblies, final erection and flight shed work. Good pay and prospects for suitable men.—Apply, stating age and particulars of experience, to Personnel Officer, Hawker Aircraft (Blackpool), Ltd., South Shore, Blackpool. [2462

CHIEF stressman required by Normalair, Ltd., to be responsible for strength calculations and compilation of type records in connection with aircraft pressurising and air-conditioning equipment. An engineering degree or equivalent is essential.

APPLICATIONS, stating age, experience, qualifications and salary required are to be addressed to Personnel Officer, Normalair, Ltd., Yeovil, Somerset. [2453

TECHNICAL writers (Electronics) required at Brentford and in Gloucestershire. Applicants must have similar previous experience, including editing and layout, and have ability to write on electronic and radar equipment.

GOOD salary and conditions. Pension scheme.

APPLY with full details, including salary, quoting No. 1490, to Personnel Manager, Sperry Gyroscope Co., Ltd., Great West Road, Brentford, Middx. [2428

JUNIOR captain required for service with Sudan Airways operating Dakotas and Doves. Commencing salary £E.1787 plus cost of living allowance. Generous home leave. Accommodation available for families. Gratuity payable on completion of 5 years' service.—Box 7430 [2479

EXPERIENCED airframe test rig designers wanted for work on new projects. Permanent posts for suitable applicants. Applications in writing should state age, experience and salary expected, and be addressed to the Chief Designer, Auster Aircraft, Ltd., Rearsby Aerodrome, Leicester. [2414

H. M. HOBSON, Ltd., invite applications for positions in the drawing office as follows: designers, detail and modification draughtsmen, checkers, stressmen. The work is concerned with interesting projects connected with fuel metering equipment and hydraulic flying controls for aircraft.—Hobson Works, Fordhouses, Wolverhampton. [0420

DRAUGHTSMEN required for interesting work at experimental airfield in connection with the installation of test equipment in the latest types of aeroplanes. Previous aircraft experience preferred.—Write, stating age, salary required, etc., to Personnel Dept., Vickers-Armstrongs, Ltd., Supermarine Works, Hursley Park, nr. Winchester, Hants. [2468

ARMSTRONG SIDDELEY MOTORS, Coventry, have vacancies for a number of designers and senior and junior draughtsmen. Although gas turbine experience is most advantageous, it is not necessarily essential as training will be given in this specialized work to suitably qualified draughtsmen.—Apply in detail to Reference F.103, Personnel Manager, Armstrong Siddeley Motors, Coventry. [0200

ARMSTRONG SIDDELEY MOTORS, Coventry require technical assistants in their Mechanical Engineering Department. Degree or H.N.C. with apprenticeship essential. Vacancies are in the sections dealing with bearing research, vibration, structure testing, etc.—Applications treated in strict confidence, should be addressed to the Technical Personnel Manager, Armstrong Siddeley Motors, Coventry, quoting Reference CG/TA.1. [2485

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HOSTEL accommodation is immediately available and housing accommodation may be available within a reasonable period for successful married applicants.

RATE of pay on entry for a five-day week of forty-four hours is 147/10 plus 26/- merit pay, with early re-assessment of merit pay up to 34/- and prospects of further advancement. Re-assessment of merit pay after 1-3 months will be retrospective to date of entry.

APPLY, giving details of apprenticeship, training (including Forces training), qualifications and experience, to the Director, Radar Research Establishment, St. Andrews Road, Malvern, Worcestershire. [2490

AIRWORK GENERAL TRADING CO., Ltd., have vacancies for electrical instrument and radio inspectors at their Blackbushe Maintenance Depot. Possession of a maintenance engineer's licence an advantage.—Apply to Chief Inspector, Airwork General Trading Co., Ltd., Blackbushe Airport, Camberley, Surrey. Tel.: Camberley 1600, Ext. 222. [2482

OPPORTUNITIES exist for first-class senior and intermediate stressmen in the development of new projects. Permanent posts at good salaries for suitable applicants. Applications in writing should state age, experience and salary expected, and be addressed to the Chief Designer, Auster Aircraft, Ltd., Rearsby Aerodrome, Leicester. [2413

INSTRUMENT technician required for the development of optical equipment for applications in mechanical engineering. Qualifications at least to Certificate of Applied Optics (Manchester) standard or equivalent. Some previous experience desirable, but not essential. Good salary and pension scheme.—Apply, quoting E.D.10, and giving particulars of qualifications, experience and age, to the Personnel Manager, Bristol Aeroplane Co., Ltd., Engine Division, Filton House, Bristol. [2461

SIR W. G. ARMSTRONG WHITWORTH AIRCRAFT, Ltd., Baginton, nr. Coventry, wish to appoint a chief jig and tool designer. Candidates must be over 30 years of age, have completed a recognised engineering apprenticeship or similar course of training. Minimum technical qualification H.N.C. Airframe experience including interchangeability media advantageous. This is a senior staff appointment with permanency, excellent prospects and conditions and an attractive pension scheme.—Write or call with full particulars to the Personnel Manager. [2481

MAJOR oil company has vacancy in head office, in aircraft refuelling vehicle operations side, for individual, 26-32 years, with good academic and engineering background and practical experience of motor vehicle fleet operation. Experience in distribution of petroleum products and knowledge of aircraft added advantages. Post entails frequent contact with airlines both in U.K. and overseas. Salary according to age, qualifications and experience. Pension scheme.—Write, quoting H.3195, and stating age, qualifications and experience, to Box 6911, c/o 191 Gresham House, E.C.2. [2466

ASSISTANT chief engineer required by company engaged in the design and development of guided weapons. Candidates must be mechanical engineers with first-class qualifications and experience in electronics and light engineering. Knowledge and experience in servo mechanisms essential since duties would include responsibility for missile control systems, electrical gyros, accelerometers, etc. Applicants should be 30-35 years of age and have sufficient personality and experience to administer and organize the development activity on these subjects.

WRITE in detail, quoting reference "G," to Box AC91033, Samson Clarks, 57-61 Mortimer Street, London W.1. [0562

MAJOR OIL COMPANY requires for employment in Venezuela multi-channel radio engineer with approximately 5 years' experience radio operating with U.H.F. techniques including time and frequency division multiplex radio equipment. Approximately 30 years of age. Must be competent to work independently and be able to co-operate in trouble-shooting and testing. Salary according to experience. Good living conditions for single or married man. Contributory pension scheme which covers both employee and family. Tours of 3 years duration, also local leave. Travelling expenses paid for interview London. Applications will be treated in strictest confidence.—Apply in writing giving full details age, qualifications, experience, to Box ZY.673, Deacon's Advertising, 36 Leadenhall St., London E.C.3. [2488

DRAUGHTSMEN required, by Ministry of Supply at various locations, with experience in any of the following classes of work: chemical plant; light or heavy mechanical; automobile; precision instrumentation; radio; radar; electrical; electronics; structural; building; jig and tool. At least three years' workshop training and O.N.C. or equivalent. Starting pay (provincial), £380 (age 20) to £550 (age 28), rising to £640. London rates higher. Paid sick leave. Twenty days' annual holiday plus public holidays; 44-hour week (generally 5-day), including meal breaks. Payment for overtime. Appointments unestablished, but opportunities to compete for pensionable posts. Prospects of promotion to leading draughtsman, £635 to £742 (provincial), thence to senior draughtsman, £742 to £910 (provincial), and chief draughtsman, £960 to £1,120 (provincial).—Write, stating age, training, qualifications and experience, to Ministry of Supply, Est. 3(c) 1, Room 519, Carlton Hotel, Haymarket, London S.W.1. [2447

SITUATIONS VACANT

ARMSTRONG SIDDELEY MOTORS, Coventry, has vacancies for six enthusiastic designers and draughtsmen who are interested in the installation of Britain's latest engines in modern aircraft. Experience desirable but not essential if applicants have energy and enthusiasm. Also vacancies for four draughtsmen with experience of design of test rigs necessary for testing engine components (high-speed bearings, oil pumps, etc.), and for the investigation of vibration and spinning problems, in connection with the development of gas turbine aero engines. All applications treated in strict confidence.—Address to The Technical Personnel Manager, Armstrong Siddeley Motors, Coventry, quoting Reference CG/DD1. [2486

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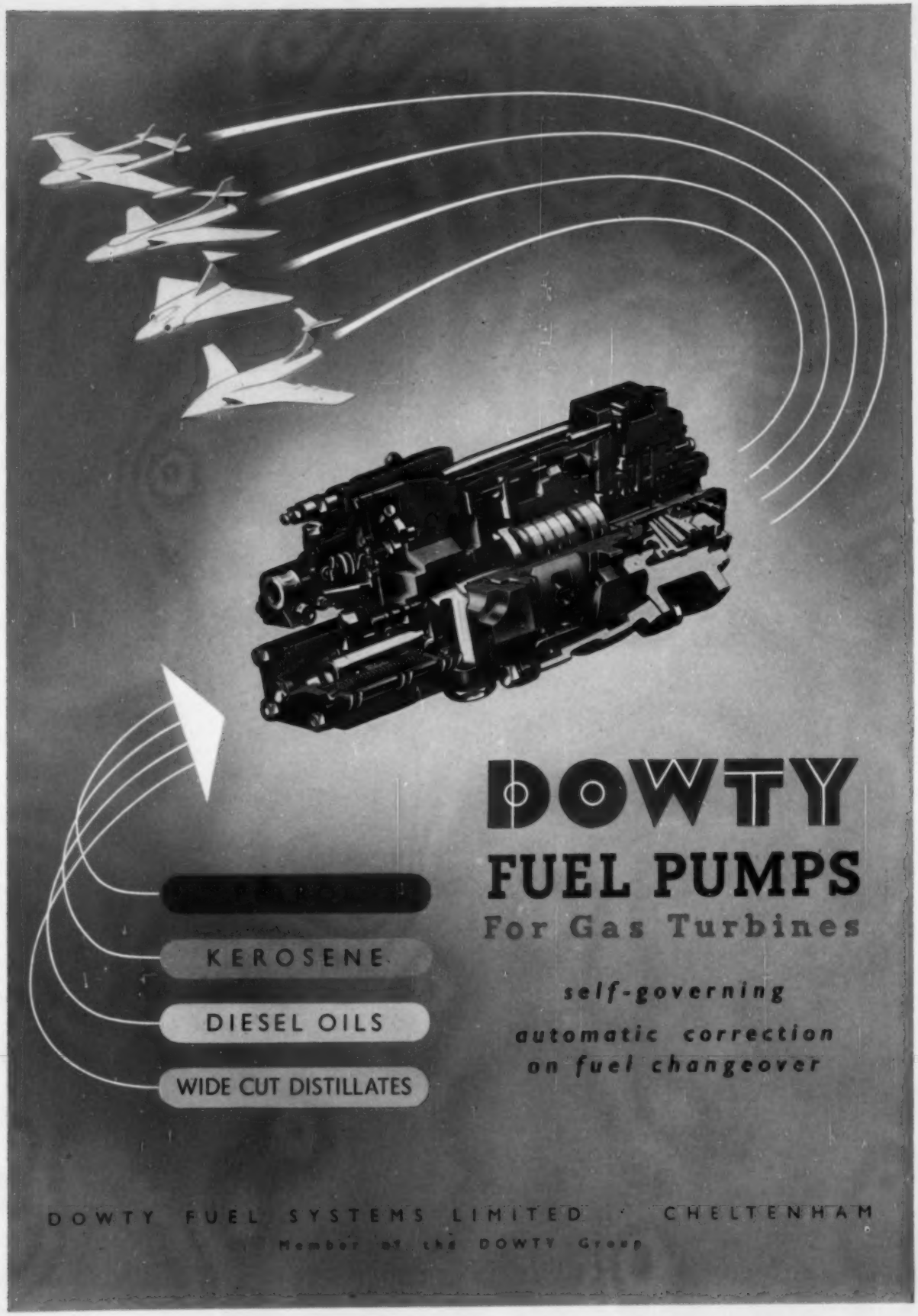
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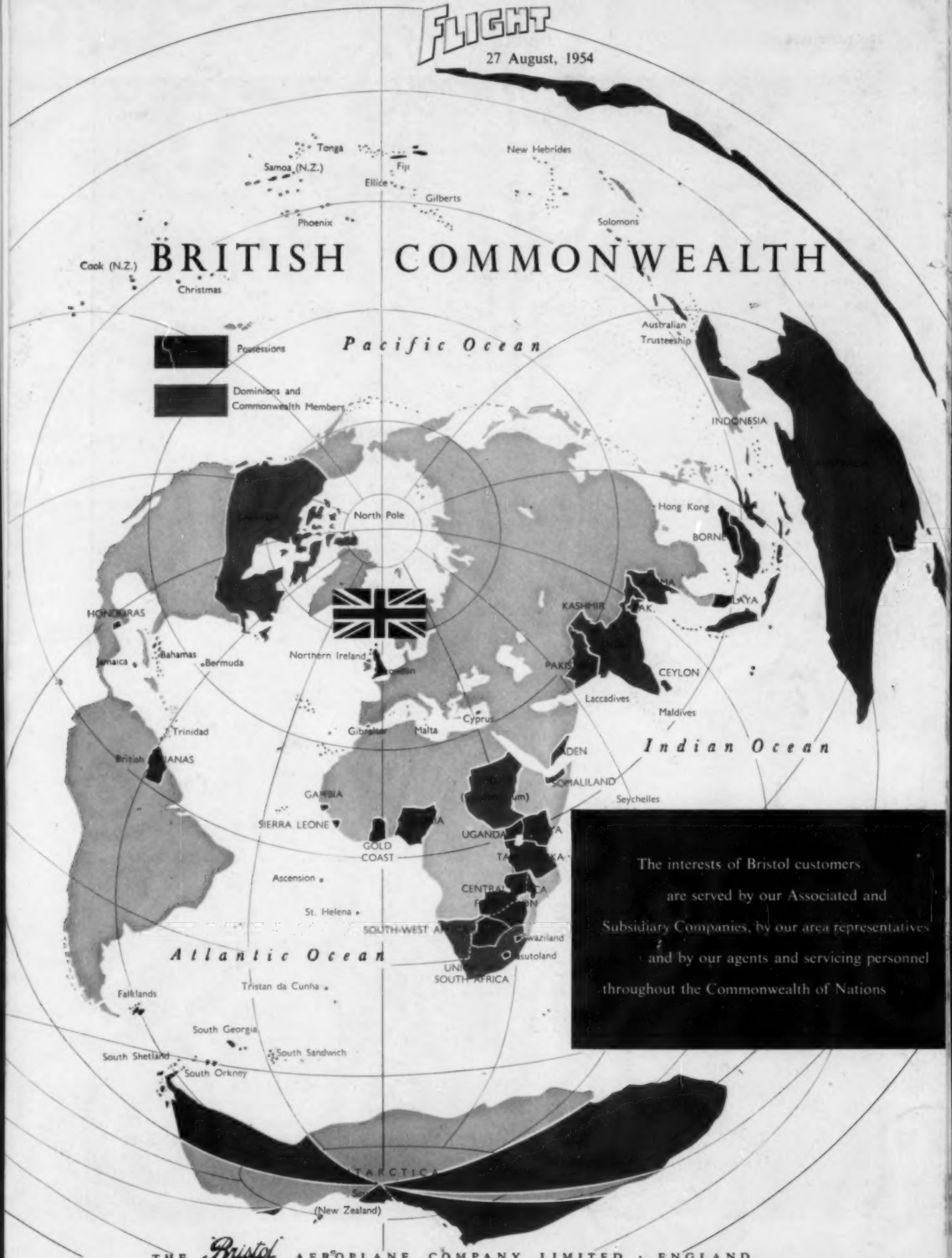

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